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DIFFERENCES IN THE COGNITIVE FUNCTIONING OF NORMAL, MENTALLY RETARDED, AND EMOTIONALLY DISTURBED SUBJECTS--IMPLICATIONS FOR SCHOOL RELEVANT DIFFERENTIAL DIAGNOSIS.

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DUNN'S PHYSICAL ANALOG THEORY OF COGNITIVE STRUCTURE AND FUNCTION WAS EXTENDED TO THE ANALYSIS OF CONCEPTUAL FUNCTIONING ASSOCIATED WITH EMOTIONAL DISTURBANCE AND MENTAL RETARDATION IN CHILDREN. THE THEORY, WHICH DESCRIBES THE INTERNAL REPRESENTATION OF INFORMATION IN THE FORM OF A COGNITIVE MATRIX OF ASSOCIATED DIMENSIONAL CONCEPTS, HAS BEEN OPERATIONALIZED BY DUNN IN THE FORM OF AN OBJECT SORTING TASK (OST). THE OST WAS INDIVIDUALLY ADMINISTERED TO SAMPLES OF 40 MALE PUPILS ENROLLED IN PUBLIC SCHOOL CLASSES FOR THE EMOTIONALLY HANDICAPPED, THE MENTALLY HANDICAPPED, AND NORMAL FOURTH-, FIFTH-, AND SIXTH-GRADERS. THE THREE GROUPS WERE EQUATED FOR AGE, AND THE EMOTIONALLY DISTURBED AND NORMAL GROUPS WERE ALSO EQUATED FOR IQ. ON ALL QUANTITATIVE DIMENSIONS OF TASK PERFORMANCE, RETARDATES WERE INFERIOR TO NORMALS, AS PREDICTED BY THEORY. HOWEVER, RETARDATES ALSO DIFFERED IN MANY QUALITATIVE RESPECTS, OFTEN TO A GREATER DEGREEE THAN DID DISTURBED SUBJECTS WHO GENERALLY OCCUPIED A POSITION INTERMEDIATE BETWEEN THE OTHER GROUPS IN TERMS OF QUANTITATIVE INDEXES. THE SPECIAL GROUPS WERE HIGHLY VARIABLE, HOWEVER, ON MOST SCORING DIMENSIONS. A CLUSTER ANALYSIS YIELDED FIVE MIXED-MEMBERSHIP GROUPS WITH HIGH "SIMILARITY COEFFICIENTS." THIS APPROACH OFFERED A POTENTIAL MEANS OF DESIGNATING MEANINGFUL CLASSIFICATIONS ALONG COGNITIVE DIMENSIONS. (PS)

REPORT 5

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DIFFERENCES IN COGNITIVE FUNCTIONING: IMPLICATIONS FOR SCHOOL-RELEVANT DIFFERENTIAL DIAGNOSIS

Philip L. Safford

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Research Report 5

IRCOPPS MIDWEST RESEARCH CENTER
FOR PUPIL PERSONNEL SERVICE

DIFFERENCES IN THE COGNITIVE FUNCTIONING OF NORMAL, MENTALLY RETARDED, & EMOTIONALLY DISTURBED SUBJECTS:

IMPLICATIONS FOR SCHOOL RELEVANT DIFFERENTIAL DIAGNOSIS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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THE UNIVERSITY OF MICHIGAN
1967

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PREFACE

The present study is the fifth in a series of basic research studies conducted by the IRCOPPS Midwest Research Center. The purpose of IRCOPPS, in its early years, is the generation of a coordinated body of information that may be brought to bear on some of the problems of the pupil personnel services. One such problem is differential diagnosis. All too often differential diagnosis rests on concepts and procedures growing out of adult psychiatric considerations. Relatively little concern has been directed toward the problems associated with a concern for the child in the school setting. For example, Kounin has shown recently that although meaningful distinctions can be made between the withdrawn syndrome and the hyperactive or acting out syndrome in the "diagnosis" of emotional disturbance in elementary school children, it is absolutely impossible to distinguish between such children in actual classroom behavior and academic performance. The purpose of the present study was to investigate differences in the perceptual-cognitive functioning of normals, retardates, and emotionally disturbed children with the hope of generating additional information to aid in the development of school relevant diagnosis.

The research reported herein was supported under NIMH Grant #01428 and is part of a larger program of such research conducted at the Midwest Center. The present study served as the research requirement for the undersigned's doctoral degree. The Center Director served as thesis chairman. Other members of the thesis committee were: John W. Hagan, M. Clemens Johnson, Melvyn I. Semmel, and Matthew J. Trippe.

Philip L. Safford

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SYNOPSIS OF STUDY

The purpose of this study was to extend Dunn's physical analog theory of cognitive structure and function to the analysis of conceptual functioning associated with two forms of maladaptive exceptionality in children, emotional disturbance and mental retardation. The theory, which describes the internal representation of information in the form of a cognitive matrix of associated dimensional concepts, has been operationalized by Dunn in the form of an Object Sorting Task (OST).

The OST was individually administered to samples of forty male pupils enrolled in public school classes for the emotionally handicapped and mentally handicapped and normal fourth, fifth, and sixth grade classes. The three groups were equated for age, and the emotionally disturbed and normal groups were also equated for IQ. In the task, the subject is asked to sort six abstract plastic objects, varying in form and color characteristics, into two groups so that all objects in a group are alike in some respect. He is then asked to explain the basis for grouping the objects in that particular way. Nine correct dichotomous sorting arrangements are possible.

In terms of the theory, disturbed subjects were predicted to differ from normals in qualitative aspects of task performance but not in quantitative aspects. Retarded subjects were predicted to differ along quantitative but not qualitative dimensions. The variables in question, deriving from both language and motor task performance indices, were related to level of conceptual attainment, nature of cognitive organization, fluency of conceptualization, ease of information retrieval, and cognitive flexibility.

The hypothesized discrepancies between retardates and normals were obtained in the study. On all quantitative dimensions of task performance, retardates were inferior to normals, the distinction being especially pronounced on the verbal indices. However, retardates also differed in many qualitative respects, often to a greater degree than did disturbed subjects, who generally occupied a position intermediate between the other groups in terms of quantitative indices.

The special groups were highly variable, however, on most scoring dimensions. Application of a computer program of cluster analysis yielded five mixed-membership groups with high "similarity coefficients." It was concluded that such an approach offered a potential means of designating meaningful classifications along cognitive dimensions.

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I. INTRODUCTION

Within the past decade, there has been a renaissance of psychological interest in cognition. Research in this area can be considered in terms of process, or structure, or both. Process research has included studies of such aspects of cognitive functioning as concept attainment, concept formation, and problem solving. Structural research has focused on the coding and storage of information received or utilized by the organism.

Different degrees of effectiveness of cognitive functioning are assumed to exist at various developmental levels and also for different populations, for example clinical populations. An important question is whether such differences are qualitative in nature, quantitative in nature, or involve both quantitative and qualitative features.

Interest in human cognitive functioning has had two general objectives: (1) to account for the commonalities found among individuals, and (2) to account for the diversity of cognitive performance found among individuals, even within presumably homogeneous groups. Regarding the former case what is of interest is the observation that, regardless of environmental or situational variability, most subjects in a given natural group, such as an age group, tend to evince a common pattern or type of performance. Regarding the latter, what is of interest is the fact that in spite of commonalities, performances of different subjects are found to differ in certain respects.

If it is assumed that some degree of commonality in cognitive functioning can be found, then a comprehensive theory of cognitive functioning must account for those universals. On the other hand, if the theory is to be comprehensive, it must allow for individual defferences in functioning. It is probably safe to assume that the task of formulating a theory capable of encompassing the entire range of individual differences is beyond the capability of contemporary psychology.

In general, developmental psychology is concerned with changes in behavior over time (Zigler, 1951). In terms of his intellective development, an individual is assumed to function differently as an adult than as a child. Such assumptions are confirmed both by superficial observation and by more rigorous and sophisticated study. The salient developmental questions pertain to the individual's capabilities and actual performance at any given point in the life cycle and to the various contingencies which may influence his current behavior or the subsequent course of his growth.

Several theories, which will be discussed subsequently, have attempted to depict the normal, sequential cognitive growth of children. These theories, in general, focus on developmental trends in the acquisition and utilization of concepts.

It is widely recognized that not all children progress in these areas in a uniform manner. Consequently, many research questions have dealt with the requisite conditions for normal development. Once again, in addition to questions pertaining to the sources of variance in performance, the issue of quantitative versus qualitative differences in functioning is relevant to such issues.

The Problem

The present investigation was based on an analogue theory of cognitive structure and function, developed by

Dunn[1], and was an attempt to extend the theory to the atypical functioning of mentally retarded and emotionally disturbed children. These forms of exceptionality were assumed to be characterized by a maladaptation which could be described in cognitive terms.

The theory was assumed to be capable of generating hypotheses concerning the patterns of functioning characteristic of relatively homogeneous groups. Whether the educational groups represented by the classifications of subjects in the study, i.e., mental retardation and emotional disturbance, could actually be differentiated along cognitive dimensions inherent in the model was considered an important question.

An additional purpose of the study, therefore, was to compare the performances of subjects across groups. It was hoped that such comparisons would suggest meaningful psychological criteria for instructional grouping in schools.

---

[1] James A. Dunn, unpublished manuscript; personal communication.

II. THEORY AND HYPOTHESES

Theories of Cognitive Functioning

Theoretical formulations of cognitive functioning have represented diverse views. Some consensus can be found across various theoretical positions, however, concerning the important role attributed to concepts in intellectual development.

The Role of Concepts

The system of concepts that evolves in the course of an individual's interaction with his environment is seen by many writers as enabling the individual to function more effectively. One's conceptual system, according to Harvey, Hunt, and Schroder (1961, pp. 2-3), "...serves as an experiential filter through which impinging events are screened, gauged, and evaluated, a process that determines in large part what responses can and will occur."

Harvey, Hunt, and Schroder stress that the behavior of an individual is the consequence of the conceptual system through which he understands his world. Sigel (1964, p. 209) has referred to concepts as "...crucial links between the environment and the individual..., intellectual tools that man uses in organizing his environment and attacking his problems." Harvey, Hunt, and Schroder (1961, p. 10) have described this function as follows:

> Concepts, in their matrix of interrelatedness, serve the critical cognitive function of providing a system of ordering, by means of which the environment is broken down and organized, it is differentiated and integrated, into its many psychologically relevant facets.

The concepts comprising the system are acquired through interaction with the environment and are organized and stored for subsequent use; thus, concepts both influence and are influenced by experience.

Although an individual's mode of conceptual functioning is dependent to some degree upon the area of experience involved, the developmental progression is generally toward greater abstractness. In the course of development, there is,

> ...an increased availability of alternative concepts or schemata for coping with the same stimuli. Thus, as progressive development occurs, a person orders the world more relativistically and less stereotypically. In other words, he operates more in terms of multiple alternatives (within a more complex and dimensionalized space) rather than in terms of bifurcated black-white categories (Harvey, Hunt, and Schroder, 1961, p. 10).

Central mediating processes, then, may involve this conceptual system.

In Piaget's theory of intellective development, the child's attainment of progressively higher degrees of conceptualization is crucial to adaptation. Even during the earliest phase of development described by Piaget, the sensorimotor phase, this developmental process is in evidence in the kinds of tasks accomplished by the child. Sigel has indicated that, at this level, the child,

> ...attains rudimentary knowledge that is the prototype of concepts---the stuff out of which concepts are made; he establishes a differentiation of himself from objects; he localizes himself in space; he establishes a beginning awareness of cause and effect, of time and space--in part because he has acquired the ability to identify the permanence and substantiality of objects early in this period (1964, pp. 214-215).

Important subsequent developmental phases in the formulation of Piaget involve the child's ability to utilize operational thought in problem solving. According to Bruner (1960, p. 35) an operation is "...a means of getting data about the real world in to the mind and there transforming them so that they can be organized and used selectively in the solution of problems."

Both Piaget and Bruner have attempted to discover the means by which the child is able to internally represent his experiences. In Piaget's view, the use of symbols of one form or another is an important factor:

> Representational thought...through symbolic capacity has the potential for simulaneously grasping, in a single, internal epitome, a whole sweep of separate events. It is a much faster and more mobile device which can recall the past, represent the present, and anticipate the future in one temporally brief, organized act (Flavell, 1963, pp. 151-152).

For Bruner, Goodnow, and Austin (1956), a concept permits an individual to see an object in terms of its identity as a member of a class. They have described conceptualization as categorization via inference, and have observed two general types of categorization; identity categorization and equivalence categorization. Categories could also be classified, they observed, as affective, functional, or formal, and the conceptual dimensions involved may be conjunctive, disjunctive, or relational. Bruner, identified several cognitive strategies, each offering certain advantages under certain circumstances. They were: simultaneous scanning, successive scanning, conservative focusing, and focus gambling.

The five stages in problem solving identified by Gagne (1959) were: (1) Presentation of the stimulus situation; (2) Concept formation; (3) Behavior determination; (4)

Decision making among alternative solutions; and (5) Verification.

Regarding the second of these stages, that of concept formation, Rosenberg (1963) has differentiated two substages--abstraction and generalization--which are equally important in determining the ultimate effectiveness of problem solving behavior. The first involves extracting from the situation a salient dimension; the second involves applying that dimension in such a way as to impose order on a given situation.

Implicit in much of the work discussed thus far is the theme of conceptualization as a major determinant of human behavior. How the individual conceptualizes a situation will influence his actions. This position has also been heavily endorsed by Kelly (1955). In Kelly's terms, the individual "...looks at his world through transparent patterns or templates which he creates and then attempts to fit over the realities of which the world is composed" (pp. 8-9). The personal constructs of an individual are "channelized," i.e., guided, directed, or determinded by the way an individual construes consequences. This view of cognitive structure posits an organized arrangement of bipolar dimensions, arranged as subordinate and superordinate constructs.

Kelly's formulation, emanating from a clinical orientation and focusing on personality determinants, is paralleled by the notion of a conceptual network or framework which acts as an "experiential filter," posited in the theory of Harvey, Hunt, and Schroder.

The preceding suggests the importance of concepts as: (a) components of cognitive structure, and (b) crucial tools in adaptation.

Theories of Cognitive Development

Piaget has viewed intelligence as "...an organizing activity whose functioning extends that of the biological organization while surpassing it due to the elaboration of new structures" (1936, p. 407). The main feature of development, according to Piaget, is the "...continuous creation of increasingly complex forms and a progressive balancing of these forms with the environment" (1936, p. 3).

These forms are called schemata and are considered to evolve in the course of the adaptive interaction of the child with his environment. In the view of Piaget, thought is always based on action, and its growth consists of the elaboration of schemata through the processes of _assimilation_ and _accommodation_. Assimilation refers to the interpretation of things or events in terms of a schema already present; accommodation refers to the necessity for some change or rearrangement of a schema in order to accommodate an experience. The interplay between these parallel processes is essential for intellectual growth, that is, adaptation. This interplay is directed toward _equilibrium_. Growth also results in the differentiation of schemata and the concommitant decrease in the child's use of egocentric thought, as a consequence of his attaining multiply-based perspectives on an object or event.

Flavell (1963, p. 53) has defined a schema as "...a cognitive structure which has reference to a class of similar action sequences, these sequences of necessity being strong, bounded totalities in which the constituent behavioral elements are tightly interrelated."

An important feature of Piaget's theory is its view of the progressive growth of intelligence through a sequence of stages which emerge in invariant order. Each stage is characterized by particular forms and modes of thought.

Bruner and his co-workers have indicated areas of disagreement with Piaget with regard to factors affecting cognitive development. To Piaget, they assert, "...cognitive development is seen as almost purely a matter of maturation, maturation that takes place by a process of internalization of logical forms" (Bruner, et al., 1966, p. 214). In their view, however, development "... is conceived more in terms of the internalization of technologies from the culture, language being the most effective technology available." (p. 214). Bruner has stated that cognitive growth "... moves forward in spurts as innovations are adopted, "most of which are "...transmitted to the child in some prototypic form by agents of the culture" (1964, p. 13).

Bruner's conceptualization of stages of development differs, in important respects from that of Piaget. In Bruner's position, greater emphasis is given to the continuity and interaction of different forms of representational thought, in that it,

> ...also stresses the differences in the ways the world can be represented: enactively, ikonically, and symbolically. Although there is a developmental sequence in terms of which--or more properly, how many--of these modes are available to a person, all three remain "in the system" throughout life, and there is always interaction among them (Bruner, et al., 1966, p. 214).

Cognitive growth has been described by Wohlwill (1962) in terms of progression along a continuum from perception to cognition. An experiment described by Inhelder and Piaget (1964) is of relevance in this connection. When presented with tasks to solve and then asked how they had solved these tasks, the youngest subjects (ages 2 ½ to about 5) described their behavior in terms of figural collections. Older children revealed that they had used a single common characteristic belonging to a set of objects. Ultimately, with oldest subjects, classifications emerged on the basis of multiple characteristics, requiring mastery of what Inhelder and Piaget called the "inclusion relation."

A parallel sequence was reported in performance patterns of children on a conservation experiment by Bruner and Kenny (in Bruner, et al., 1966). Similarly, Sigel (1953), in a study of categorization, found that, with increasing age, children tended less to respond on a perceptual basis and tended more to respond on a conceptual basis.

Another approach to the study of conceptual development is represented in the work of Vigotsky (1962).

Vigotsky identified three basic phases in cognitive development, each of which was subdivided into stages. Concept formation was the final stage, considered to emerge fully by adolescence, although in evidence in embryonic form during earlier periods.

Vigotsky used an object sorting task to analyze the characteristic features of thought associated with each level. In this task, subjects were required to sort twenty-two blocks, varying in several color, form, and size dimensions, into groups. Sequential progression was seen from sorting in "unorganized congeries or 'heaps'," (p. 59), through a period of "thinking in complexes," (p. 61), to the ability to form concepts. The distinction between complexes and concepts was described as follows:

> The principle function of complexes is to establish bonds and relationships. Complex thinking begins the unification of scattered impressions; by organizing discrete elements of experience into groups, it creates a basis for later generalizations" (p. 76)

In concept formation, it is "...necessary to abstract, to view the abstracted elements apart from the totality of the concrete experience in which they are embedded"

(p. 76). Ultimately, "A concept emerges only when the abstracted traits are synthesized anew and the resulting abstract synthesis becomes the main instrument of thought" (p. 78).

Hanfmann and Kasanin (1942), in their use of the Vigotsky object sorting method, also identified three stages, which roughly parallel those of Vigotsky. At the first stage, subjects evidence a categorical attitude in grouping objects according to, e.g., form, rather than considering them as discrete entities. The second stage is characterized by insight into the multiple possibilities of the choice. Finally, at the third stage, consideration of the total system is demonstrated.

Hanfmann and Kasanin (1942, p. 10) have described the advantages of the Vigotsky method:

> ...use of concepts has a definite functional value for the performance required by this test. Whether the subject actually uses conceptual thinking in trying to solve the problem...can be inferred from the nature of the groups he builds and from his procedure in building them. Nearly every step in his reasoning is reflected in his manipulation of the blocks.

The theories of Piaget, Bruner, Vigotsky, and Hanfmann and Kasanin emphasize a sequence of conceptual development which culminates in the emergence of abstraction as a highly efficient cognitive tool.

Werner (1948, p. 234), however, felt there were analogous processes of abstraction which could be seen at every level, not just the last one. He identified these levels as the level of bodily cues, the level of concrete perceptual relationships, and the level of conceptual activity. In this respect, his view was not unlike that of Piaget. Abstraction at the first and second levels was considered to be a mode of thought that "... is simply logical in another, self-contained sense" (p. 16). Werner felt there were parallels between the thinking of children and that of primitive man:

> Among primitive peoples, and also children, there is found a kind of thinking which, with great justification, may be termed 'concrete' thinking. Its distinctive characteristic lies in the fact that the conceptual activity operates in indivisible unity with motor-perceptual and imaginative processes. It is only gradually that a non-sensori-motor--that is, abstract--mode of thinking separates itself from this unity (p. 52).

According to Werner, the function of thought is that of a mediator, regulator, and organizer of subsidiary processes.

Werner posited five principles of development, the first of which he termed the Orthogenetic Law. According to this principle, development proceeds from global perceptions toward increasing differentiation, that is, away from "syncretic" thinking. Associated with this increased differentiation is an increased ability to think hierarchically, i.e., to subordinate, and to integrate.

Intelligence tests generally approach the description of a child's intellective ability in simple quantitative terms. It is felt, however, that the views summarized in the preceding pages suggest an alternative, qualitative, means by which a child's level of intellectual ability may be described.

The Theoretical Framework of The Present Study: Cognitive Matrix Theory

The present investigation was carried out within the context of an analog theory of cognitive development and cognitive functioning. Dunn's matrix theory uses a physical analog model to represent the organization of information within an individual's cognitive structure. In this model, reference points in hyperspace form conceptual classification dimensions which may in turn, be grouped into superordinate regions.

Thus, concepts are represented as associated points in space, and the associations, or linkages, between particular pairs of points represent conceptual or classificatory dimensions, the two points being the poles of the dimension. Points which are located in a particular region of the cognitive structure presumably have maximal relationship. A point may be associated with points located in other, more distant, regions, however.

This network of associated and grouped points in space comprises a cognitive matrix, which is assumed to be continuously changing. New associations are made, new content is added, and new dimensions are formed as needed, or as demanded by experience. The variables affecting the size and nature of the matrix are the extent and utility of the matrix at any given point in time and also the experiences to which the individual is exposed in the course of his interaction with the environment.

The model is dynamic in that it allows for continuous alteration in the size of the cognitive structure, that is, in the number of concepts present. Such alteration can be achieved by expansion, through the introduction of new elements, or through further differentiation and reintegration.

of those elements already present. These growth mechanisms correspond to the processes of assimilation and accommodation in Piaget's formulation. Alteration in the structure can also be achieved, however, by contraction of the matrix, through the consolidation of elements or through extinction.

The observations and theory of Piaget, therefore can be interpreted in terms of cognitive matrix theory. Similarly, the model can reflect developmental levels of conceptual attainment, in terms of the extensity of the cognitive matrix of an individual. The degree of conceptual sophistication is reflected in the nature of the dimensionalities, that is, in terms of the elements, or points, which are associated in order to form conceptual dimensions.

The structural organization of information is only one aspect of the model, however. Of particular importance in performing operations are the conditions for information retrieval.

The model specifies conditions for accessibility of concepts. Although regional proximity may be important, topographical distance is not equated with functional distance. The latter is defined in terms of the number of operations, or steps, required in data processing, the amount of resistance encountered at each step, and the amount of energy which is available. Thus, not only concept accessibility, but also such phenomena of cognitive functioning as remote associations (Mednick, 1962) and cognitive fluency and flexibility (Guilford, 1959; Torrance, 1960) may be viewed in connection with the theory.

The idea of cognitive matrix is related to information theories in that it is concerned with the data-processing aspects of cognitive functioning, especially with regard to storage arrangement and information retrieval.

Unlike information theory, however, it is developmental in orientation. That is, matrix theory also specifies the conditions for acquisition of information and the changes in this aspect of the system in the course of development.

Kelly's representation of conceptual dimensions as polarities is of relevance to the model, as are his notions of subordinate and superordinate constructs and the adaptive value of orthogonal resolutions to conflictive dichotomous dimensions.

Although Sullivan has not usually been viewed as a cognitive theorist, his description of the growth of the self-concept and other-concept is likewise relevant.

According to Sullivan (1953) the infant first forms a concept of *me - not-me*; the latter becomes differentiated as *good-breast - bad-breast*, which in turn affects a differentiation of the former as *good-me - bad-me*. In Sullivan's view, the infant's construction of himself and his world is largely dependent on the formulation of dichotomous conceptual dimensions, the differentiation of concepts, the acquisition of new concepts in relationship to those already present, and the re-integration of concepts in the formation of new dimensions.

Considerable discussion is subsequently devoted to various notions relating to style of conceptualization. The physical structure model can be seen as focusing on individual differences in functioning, based on individual differences in the number and nature of concepts, which in turn affects the number and the nature of dimensions present. An additional important consideration relates to the characteristics of the linkages which associate concepts within the cognitive matrix.

Also, the various factors affecting time required in data processing for concept utilization in performance can be viewed in connection with personality variables involved.

Kagan (1965) has described differences in "conceptual tempo" in terms of a dimension of impulsivity versus reflectiveness.

Extension of the Theory and General Hypotheses

Observation of special populations of children, such as those who have been classified as emotionally disturbed or as intellectually limited, reveals varying degrees of child success in environmental-social adaptation. Piaget's notion of adaptation, the ability to interact with the environment in such a way as to insure survival and to promote the well-being of the organism, requires the child to assimilate new experiences or to accommodate to them. In terms of Dunn's model of the cognitive matrix, the child must have at his disposal the concepts necessary in order to assimilate the new element, or he must be able to affect a structural re-arrangement permitting the acquisition of the new element.

Children who have been regarded as highly creative may be those with unusually effective potentialities for adaptation. They can process information via remote associations (Mednick, 1962) of elements within the matrix, or relate novel ideas to common stimuli (Guilford, 1950;

Torrance, 1960). Such children may be conceptualized as having a highly flexible cognitive matrix. Their thinking, and often their social behavior, may at times be nonconforming as a consequence, however, and frequently idiosyncratic. Nevertheless, problem solving ability, productivity, and achievement often appear to be enhanced (Getzels and Jackson, 1962).

While the cognitive structure of the very creative child could be larger than that of a less creative peer, it most certainly would be characterized by more complex conceptual linkages. Futhermore, rather than simple stereotyped linkages, these associations may be quite unique and not bound by consensual limitations. This child can entertain highly novel hypotheses, if he desires, but he has the freedom to use this ability as he chooses.

The emotionally maladjusted child, on the other hand, has been described as lacking "degrees of freedom" (Bower, 1965, 1966). In the terms of ego psychology, important ego functions and ego organization are impaired. Although in some respects his thinking may resemble that of the creative child, his "remote associations" are, presumably, less valid. His ideas are frequently too egocentric and idiosyncratic to be of much long range survival value. When confronted by a task, he may be able to do no more than refer randomly to his cognitive matrix, neither able to assimilate nor accommodate to the experience. While the emotionally disturbed child's concept repertoire--i.e., his cognitive matrix--may be no smaller than that of the normal child, it may often be much more loosely or unusually connected, so that his ability to adapt to the environment is uncertain and inconsistent.

Within this conceptual framework, the cognitive matrix of the child regarded as mentally retarded may also be viewed as inadequately developed. However, in this case the differences between the cognitive structures of a normal and of a retarded child may be primarily quantitative, rather than qualitative, in nature. Adaptation may be impaired because of the limited complexity and extensiveness of the relational connections within the matrix; that is, fewer linkages and fewer elements are present. In other words, fewer experiences have been assimilated and the linkages are relatively simple and direct. Each new experience requires an accommodation on the part of the retarded child, involving a new orientation and structural rearrangement.

The position which has been described above suggests several hypotheses, which will be cast in operational terms. They are: (1) There are no differences between normal and emotionally disturbed children in size of the cognitive matrix, but (2) There are qualitative differences in the nature of the relationships represented; (3) There are differences between normal and mentally retarded children in size of the cognitive matrix, but (4) There are no qualitative differences in the nature of the relationships represented.

Such a position reflects the assumption that both emotionally disturbed and mentally retarded children can be viewed as possessing impaired or limited adaptive ability. In each case, the cognitive matrix lacks the survival utility which characterizes that of the normal child. In one instance, the difference is expected to be quantitative, and in the other it is expected to be qualitative.

If these groups are found to differ from each other and from the normal population in the organizational and functional nature of their cognitive structures, specific predictions can be made concerning their conceptual performance and theoretical remediation and/or behavioral modification techniques can be considered.

III. INTELLECTIVE FACTORS IN COGNITIVE FUNCTIONING AND CHARACTERISTICS ASSOCIATED WITH MENTAL RETARDATION

The importance of subject variables, that is, certain characteristics which differentiate some subjects from others, has been increasingly recognized in psychological research. Atkinson (1964, p. 276) has stressed "... the general need of psychology to bring about an integration of the study of individual differences and basic behavioral processes." As Hovland (1960, p. 632) has noted, "...every worker in the field is struck by the wide variability from individual to individual in even the simplest types of learning."

Perhaps the two most obvious types of subject variables are age and sex. The relationships between chronological age and conceptual performance would seem superficially obvious. Presumably, older individuals, if consideration is restricted to children and other relevant variables are controlled, have access to more information and manifest a more highly developed conceptual system than do younger individuals. Such observations, in fact, have formed the basis for the original validation of intelligence tests (see, for example, Terman and Merrill, 1960). The relationship between sex and conceptual performance may be less obvious. Some studies, (e.g., Terman, 1947) have noted the differential growth trends in measured IQ for males and for females. Kagan (1964) and Kagan and Moss (1962) have discussed the influences of culturally imposed sex role standards on cognitive functioning.

Cognitive Functioning in Mental Retardation

In the field of education, it has been axiomatic that individuals of the same age may differ with respect to their ability to learn. Hovland (1960) noted that experimental studies of various kinds had typically tended to show high correlations between mental age (MA) and learning scores. However, citing a number of such studies, he concluded that no decisive evidence of a generalized learning ability had as yet been obtained. The definition of intelligence as a generalized "ability to learn" could be challenged, he observed, on the basis of this lack of experimental evidence.

Sigel (1964) concluded that, although the usual measures of mental ability do not reflect the crucial aspects of or requisites for concept attainment in children, research with the mentally retarded has generally suggested that the level of conceptualization is affected by the degree of retardation. Sigel noted, however, the common observation of great variability within IQ categories of retardates on cognitive tasks and concluded that an important goal of research in mental retardation should be to specifically identify the deficits in concept learning and the cognitive processes involved in these deficits.

Ellis (1963) has asserted that IQ, and consequently MA, are low-order explanatory variables.

In reviewing research on problem solving, Rosenberg (1963) observed that only the more recent studies had focused on process. Of the two general classes of study design, comparative and experimental, most research with retardates had been of the former type rather than the latter. According to Rosenberg, the chief task for research should be to identify the variables which facilitate or interfere with problem solving and conceptual behavior. Such identification would require the experimental manipulation of some variable.

Some studies have suggested that subjects differing widely with respect to MA may learn in different ways.

White (1963) cited studies suggesting that younger and duller children may learn more gradually than those of higher chronological or mental age. This may enable the retarded individual to perform more accurately, and in some cases more efficiently, on some learning tasks.

Many studies have investigated the role of verbal mediation in the cognitive performances of subjects of differing MA. Sanders, Ross, and Heal (1965) found that observed differences in the learning processes of normal children and retardates were evidenced by the universal use of mediational processes among the former in contrast to the latter. Thus, in their study, reversal shifts were easier for normal subjects than were nonreversal shifts. The research of Kendler and Kendler (e.g., 1959, 1961) has stressed the role of mediational processes in explaining differential performances on tasks of transposition learning. Zeaman and House (e.g., 1958), on the other hand, have explained differential performances of normals and retardates on transposition learning tasks on the basis of differential attentional processes.

A study which focused on the role of verbal mediation in children's conceptual sorting of objects was conducted by Carey and Goss (1957). Eight blocks were presented to four groups of four and five year old children. The blocks varied in size and in height and represented dimensional combinations of these attributes. One group of subjects was given a familiar word label to learn in association with the blocks prior to being asked to sort them. A second group learned a nonsense syllable, the third was given no label but merely allowed to see the blocks prior to being asked to sort them, and the fourth was given no prior exposure. Subjects were then asked to sort the blocks into four categories in terms of height and size. Labeling with a familiar word was found to effect positive transfer to sorting as evidenced by faster learning of the correct sorts. However, Hermelin and O'Connor (1957) found pretraining on verbal mediators unrelated to responses of imbeciles to common characteristics of objects.

As Rosenberg (1963) has noted, in studies involving simple and double alternation problem solving tasks, successful performance has correlated well with MA, although often retardates who respond correctly on the task are unable to provide a verbal rationale for their behavior.

Rosenberg (1963, p. 459) concluded that, "... under certain conditions some mental defectives are capable of problem-solving, abstract learning, abstract performance, and generalization despite evidence of an inability to identify verbally the relevant dimensions of similarity."

Also pertaining to the relationship of language to conceptual behavior of retardates was a study conducted by Griffith, Spitz, and Lipman (1959). The findings of this study suggested that differential concept formation performance between normal and retarded subjects could be accounted for on the basis of a mediational hypothesis. Other work by Griffith and his associates (e.g., Griffith and Spitz, 1958; Griffith, 1960) has been concerned with the relationship between a subject's ability to abstract a common property from a verbal triad and his ability to define the words in the triad.

Another approach to the study of cognitive deficits associated with mental retardation has been directed toward the investigation of perceptual processes. Spitz and his associates (Lipman and Spitz, 1961; Shoto, Miller, and Spitz, 1963; Spitz, 1964) have conducted research focusing on the phenomenon of rigidity in retardates.

Their approach, unlike that of Kounin (1941) or Stevenson and Zigler (1957), culminated in a physiochemical theory of "cellular torpidity." Spitz and his associates have employed such illusions as the visual figural aftereffect and the Necker Cube illusion in testing the hypotheses generated by the theory.

The abstract - concrete dichotomy in the formulation of Goldstein and Scheerer (1941) has generated a large number of studies involving retardates. According to the theory, both response tendencies, abstract and concrete, are present in normal individuals, but only the concrete is present in such abnormal conditions as schizophrenia and brain injury. The abstract attitude is reflected in the ability to consciously respond to common properties of objects and events which are otherwise dissimilar, and to shift response from one dimension of similarity to another. The concrete individual, on the other hand, is unaware of common properties of objects and events and is therefore unable to respond to them.

According to Rosenberg (1963), the research which has been conducted with retardates in terms of the theory has been entirely dichotomous, concerning the question of whether retardates are concrete in their conceptual behavior. However, in their original formulation, Goldstein and Scheerer (1941, p. 8) referred to "... various degrees of abstract behavior corresponding to the degree of ideational complexity which the performance in question involves." The maximal utilization of abstract thinking, in their view, "...is required for the conscious and volitional acts of forming generalizations and hierarchic concepts or of thinking in terms of a principle and verbalizing the acts" (1941, p. 8).

Indices of abstract or concrete conceptual behavior were obtained via examination of subjects' performance on five tests. A brief description of each test follows.

1. The Goldstein-Scheerer Cube Test
   The cubes used in this test were four small Kohs blocks, each surface of each block either a single solid color or two colors diagonally divided. S was first given the Ishihara Color Test, then asked to name the colors on the blocks. Next, E named the colors and asked S to copy the designs formed by juxtaposition of the blocks. Concrete Ss employed no analytical reasoning, but "...respond unreflectingly to the task of 'copying'" (1941, p. 32).

2. The Gelb-Goldstein Color Sorting Test
   In this test, the subject's task was to sort wool skeins differing in hue. The critical question was S's ability to employ color concepts, specifically the concept of hue, in sorting.

3. The Gelb-Goldstein-Weigl-Scheerer Test

   Two sets of varying objects were employed in this test, one set for male Ss and one for females. Administration of the test involved five specific experiments: the grouping of articles relating to the choices of S and E; arranging all the articles into separate groups; choosing another way of grouping the articles; asking S why a grouping performed by E was appropriate; and a control experiment for the questioning procedure.

4. The Weigl-Goldstein-Scheerer Color Form Sorting Test

   In this test, S was presented with twelve figures, including squares, triangles, and circles, and differing in color. S was asked to sort the figures in one way and then to shift to another way and provide an explanation for the new arrangement. Ss using the abstract approach were those who approached the task in terms of a category either of color or of form. Concrete Ss tended to treat the figures as individual things rather than as members of a class.

5. The Goldstein-Scheerer Stick Test

   In this test, the S was first asked to copy stick figures, and then to reproduce them from memory. One of the advantages of this test, in the view of the authors, was the fact that, "They are abstract features in an abstract geometrical space, bearing no direct reference to a tangible life situation" (1941, P. 12).

The Goldstein-Scheerer formulation, despite its apparent heuristic merits, has been subject to criticism. Weatherwax and Benoit (1957) criticized what Rosenberg referred to as the "... questionable validity of the underlying theory which insists upon a dichotomization of abstract and concrete and the necessity for conscious awareness of relevant conceptual dimensions as the sine qua non of abstract behavior" (1963, p. 454). This criticism is related to the observation of Rosenberg, cited earlier, that in many kinds of tasks retardates often appear to utilize abstraction despite the inability to identify verbally the basis for their behavior.

The tests described above have been employed by Halpin (1958) and by Halpin and Patterson (1954) in studies with retardates. In the former study, with a large sample of retarded children,aged seven through fourteen, Halpin found that neither color nor form preference was related either to CA or MA, nor were pattern responses. Impairment in category shifting ability was found to decrease significantly as a function of increasing CA. Halpin and Patterson matched brain-injured and familial retardates on both MA (range = 4 - 7) and CA (range = 9 ½ - 13 ½). No significant differences were found between the groups in the initial principle used in sorting or in the ability to shift the principle for sorting. The only significant difference pertained to the production of patterns during sorting, with a greater proportion of familials producing patterns.

The tendency of retarded child subjects to employ position reversal rather than dimension reversal on an experimental task was reported by Milgram and Furth (1964).

Stephens (1966) found retarded subjects inferior to normals matched on CA in using categories provided for the grouping of materials, as well as in identifying the categories they already had used successfully.

Inferior performance of retarded subjects as compared with normals was reported by Siegel (1957) in a study involving the administration of the Visual-Verbal Concept Formation Test to both groups. Retarded subjects were specifically impaired in their ability to shift the basis of selection of pictured stimuli from one relevant dimension of similarity to another, and also in the ability to verbalize the relevant dimensions of similarity.

The notion of an abstract - concrete dichotomy was initially formulated in terms of abnormal conditions such as brain injury. That the conceptual performance of retardates could also be characterized as concrete was considered secondarily. A number of theoretical positions and research approaches have posited similarity or difference between brain-injured and retarded individuals in terms of their respective characteristics of cognitive functioning.

One such position was that of Strauss and Werner (1942), who found that brain-damaged child subjects tended to sort objects in an idiosyncratic manner and to offer far-fetched explanations for their groupings. In addition, these subjects often revealed an inability to refrain from attending to irrelevant features of the objects when sorting. When presented with a collection of fifty-six objects, brain-injured subjects used more objects and made more groupings than did familial retardates in an experiment conducted by Strauss and Werner. Although verbal explanation of groupings were predominantly functional in both groups, those offerred by brain-injured _S_s were typically more bizarre and, in contrast to the familial group, were sometimes both bizarre and non-functional.

McMurray (1954) compared the performances of exogenous and endogenous retardates on a modified version of the Wisconsin Card Sorting Task, a measure of certain aspects of conceptual behavior. In this task, a series of cards, containing items varying in color, form, and number, was presented. Nonverbal abstract performance and the ability to shift dimensions in recognizing similarities were measured. Non-brain-injured subjects were found to perform better on all indices, making fewer perseverative sorting errors and requiring less time and fewer trials to reach criterion.

Similar findings were reported by Barnett, Ellis, and Pryer (1960), who compared the performances of MA- and CA- matched brain-injured and familial retardates on a double alternation task. Brain-injured subjects required significantly more trials to reach criterion in learning the double alternation problem.

The view that endogenous and exogenous retardates differ significantly in cognitive functioning, or respond differently to particular educative approaches, has been questioned on the basis of findings of several studies, in particular the research of Gallagher (1957). According to Gallagher (1960), it is difficult to ascertain to what extent brain injury affects the higher mental processes. The relationship of brain injury to cognitive processes, he asserted, is found in its characteristic effects on perception which in turn inhibits concept formation. Gallagher reported substantial within-group variance, and considerable variation in the effects of brain damage. These effects, he suggested, are dependent upon such factors as localization, severity, type, chronicity, and age at onset.

The presence of organic brain injury has often been found to pose a difficult diagnostic problem (see, for example, Cruickshank, 1961). Halstead (1947), whose diagnostic procedures involved administration of a battery of tests, pioneered in the use of particular task indices as indicators of the locus and effects of brain injury. Halstead's battery included, among other tasks, a measure of conceptualization involving block sorting. The work of Reitan (1955; 1959) has represented even more intensive efforts to predict locus, type, and severity of organic brain damage on the basis of indices including performance on concept formation tasks.

It would appear evident from much of the research in mental retardation cited thus far that the issue of basic differences between groups, such as normal versus retarded, endogenous versus exogenous, etc., has been an important one. Zigler (1966), however, has criticized what he termed the "difference orientation" in work with retardation, and has stressed the lack of consistent research evidence in support of any of the proposed "differences," at least for familial retardates.

The work of Zigler and his co-workers (Stevenson and Zigler, 1957; Zigler, Hodgden, and Stevenson, 1958; Zigler, 1961; Green and Zigler, 1963; etc.) has consistently stressed the motivational implications of retardation itself, and of the environmental conditions most frequently associated with retardation. Zigler (1963) has urged that the possible adverse effects of deprivation of social reinforcement in the histories of many retardates be thoroughly investigated.

The view that mental retardation is not a unitary syndrome with which certain forms of cognitive behavior are invariably associated has been expressed by workers such as Kessler (1966, pp. 89-90) and Heber (1964, p. 169).

Problems encountered in determining the intellective aspects of mental retardation may represent one aspect of the broader problems of the nature and measurement of intelligence itself, according to Zigler (1966). He has suggested the possible merits of "... reorienting or restructuring our approach to intellectual retardation" to a "concern with cognitive processes" (1966, p. 113).

Laurendeau and Pinard (1962) have noted that Piagetian tasks, in contrast to the usual intelligence tests, permit investigation of the cognitive processes in operation which produce the score or result. Using Piaget's questions designed to assess the child's developing concepts of causality, Laurendeau and Pinard have constructed a standardized test. They have observed a decrease in children's responses indicating precausal thinking as a function of CA. Mary Woodward, whose research with severely deficient institutionalized retardates has involved the use of Piagetian tasks, has also stated that such tasks permit examination and evaluation of process rather than simply outcome (1963).

The possibilities for the application of stage-attainment aspects of Piaget's theory to retardation has been suggested by Inhelder (1944), who felt that these stages could be used as a new means of classifying grades of mental deficiency. The experiment used by Inhelder in placing subjects on a developmental scale suggested to Hunt (1960, p. 260) the possibility of a "... natural ordinal scale of conceptualization and intelligence." The experiment was designed to determine the existence in subjects of conservation of quantity, weight, and volume. Inhelder found that every subject who showed conservation of volume also showed conservation of weight and quantity, and each subject who showed conservation of weight also showed conservation of quantity, thus confirming the Piagetian stage hypothesis.

An example of Woodward's applications to the assessment of conceptual development in retardates was a study with institutionalized defectives, all of whom failed to reach the basal level (age two) on the Stanford - Binet Intelligence Scale. Using Piaget's sensorimotor stages, Woodward compared the stages reached by subjects in problem solving with stages reached in the development of a concept of object permanence. Correspondence between these indices was found in eighty-seven per cent of the sample in her study. A high degree of correspondence was also found when subjects were classified according to the stage sequence in terms of evidences of primary, secondary, and tertiary circular reactions, and compared to their stage level of sensorimotor intelligence.

Woodward (1959) also observed that bizarre manneristic behavior, such as hand movements, among severe defectives were similar to those of infants aged two and three months. She concluded that these mannerisms originated in both instances in the course of coordinating vision and grasping schemata, as Piaget had described in connection with early sensorimotor development.

In summarizing attempts to apply Piagetian stage theory to the study of mental retardation, Sigel (1964,

REPORT RESUMES

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DIFFERENCES IN THE COGNITIVE FUNCTIONING OF NORMAL, MENTALLY RETARDED, AND EMOTIONALLY DISTURBED SUBJECTS--IMPLICATIONS FOR SCHOOL RELEVANT DIFFERENTIAL DIAGNOSIS.

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MICHIGAN UNIV., ANN ARBOR

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DUNN'S PHYSICAL ANALOG THEORY OF COGNITIVE STRUCTURE AND FUNCTION WAS EXTENDED TO THE ANALYSIS OF CONCEPTUAL FUNCTIONING ASSOCIATED WITH EMOTIONAL DISTURBANCE AND MENTAL RETARDATION IN CHILDREN. THE THEORY, WHICH DESCRIBES THE INTERNAL REPRESENTATION OF INFORMATION IN THE FORM OF A COGNITIVE MATRIX OF ASSOCIATED DIMENSIONAL CONCEPTS, HAS BEEN OPERATIONALIZED BY DUNN IN THE FORM OF AN OBJECT SORTING TASK (OST). THE OST WAS INDIVIDUALLY ADMINISTERED TO SAMPLES OF 40 MALE PUPILS ENROLLED IN PUBLIC SCHOOL CLASSES FOR THE EMOTIONALLY HANDICAPPED, THE MENTALLY HANDICAPPED, AND NORMAL FOURTH-, FIFTH-, AND SIXTH-GRADERS. THE THREE GROUPS WERE EQUATED FOR AGE, AND THE EMOTIONALLY DISTURBED AND NORMAL GROUPS WERE ALSO EQUATED FOR IQ. ON ALL QUANTITATIVE DIMENSIONS OF TASK PERFORMANCE, RETARDATES WERE INFERIOR TO NORMALS, AS PREDICTED BY THEORY. HOWEVER, RETARDATES ALSO DIFFERED IN MANY QUALITATIVE RESPECTS, OFTEN TO A GREATER DEGREEE THAN DID DISTURBED SUBJECTS WHO GENERALLY OCCUPIED A POSITION INTERMEDIATE BETWEEN THE OTHER GROUPS IN TERMS OF QUANTITATIVE INDEXES. THE SPECIAL GROUPS WERE HIGHLY VARIABLE, HOWEVER, ON MOST SCORING DIMENSIONS. A CLUSTER ANALYSIS YIELDED FIVE MIXED-MEMBERSHIP GROUPS WITH HIGH "SIMILARITY COEFFICIENTS." THIS APPROACH OFFERED A POTENTIAL MEANS OF DESIGNATING MEANINGFUL CLASSIFICATIONS ALONG COGNITIVE DIMENSIONS. (PS)

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DIFFERENCES IN COGNITIVE FUNCTIONING: IMPLICATIONS FOR SCHOOL-RELEVANT DIFFERENTIAL DIAGNOSIS

Philip L. Safford

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Research Report 5

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IRCOPPS MIDWEST RESEARCH CENTER
FOR PUPIL PERSONNEL SERVICE

DIFFERENCES IN THE COGNITIVE FUNCTIONING OF NORMAL, MENTALLY RETARDED, & EMOTIONALLY DISTURBED SUBJECTS:

IMPLICATIONS FOR SCHOOL RELEVANT DIFFERENTIAL DIAGNOSIS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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PREFACE

The present study is the fifth in a series of basic research studies conducted by the IRCOPPS Midwest Research Center. The purpose of IRCOPPS, in its early years, is the generation of a coordinated body of information that may be brought to bear on some of the problems of the pupil personnel services. One such problem is differential diagnosis. All too often differential diagnosis rests on concepts and procedures growing out of adult psychiatric considerations. Relatively little concern has been directed toward the problems associated with a concern for the child in the school setting. For example, Kounin has shown recently that although meaningful distinctions can be made between the withdrawn syndrome and the hyperactive or acting out syndrome in the "diagnosis" of emotional disturbance in elementary school children, it is absolutely impossible to distinguish between such children in actual classroom behavior and academic performance. The purpose of the present study was to investigate differences in the perceptual-cognitive functioning of normals, retardates, and emotionally disturbed children with the hope of generating additional information to aid in the development of school relevant diagnosis.

The research reported herein was supported under NIMH Grant #01428 and is part of a larger program of such research conducted at the Midwest Center. The present study served as the research requirement for the undersigned's doctoral degree. The Center Director served as thesis chairman. Other members of the thesis committee were: John W. Hagan, M. Clemens Johnson, Melvyn I. Semmel, and Matthew J. Trippe.

Philip L. Safford

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SYNOPSIS OF STUDY

The purpose of this study was to extend Dunn's physical analog theory of cognitive structure and function to the analysis of conceptual functioning associated with two forms of maladaptive exceptionality in children, emotional disturbance and mental retardation. The theory, which describes the internal representation of information in the form of a cognitive matrix of associated dimensional concepts, has been operationalized by Dunn in the form of an Object Sorting Task (OST).

The OST was individually administered to samples of forty male pupils enrolled in public school classes for the emotionally handicapped and mentally handicapped and normal fourth, fifth, and sixth grade classes. The three groups were equated for age, and the emotionally disturbed and normal groups were also equated for IQ. In the task, the subject is asked to sort six abstract plastic objects, varying in form and color characteristics, into two groups so that all objects in a group are alike in some respect. He is then asked to explain the basis for grouping the objects in that particular way. Nine correct dichotomous sorting arrangements are possible.

In terms of the theory, disturbed subjects were predicted to differ from normals in qualitative aspects of task performance but not in quantitative aspects. Retarded subjects were predicted to differ along quantitative but not qualitative dimensions. The variables in question, deriving from both language and motor task performance indices, were related to level of conceptual attainment, nature of cognitive organization, fluency of conceptualization, ease of information retrieval, and cognitive flexibility.

The hypothesized discrepancies between retardates and normals were obtained in the study. On all quantitative dimensions of task performance, retardates were inferior to normals, the distinction being especially pronounced on the verbal indices. However, retardates also differed in many qualitative respects, often to a greater degree than did disturbed subjects, who generally occupied a position intermediate between the other groups in terms of quantitative indices.

The special groups were highly variable, however, on most scoring dimensions. Application of a computer program of cluster analysis yielded five mixed-membership groups with high "similarity coefficients." It was concluded that such an approach offered a potential means of designating meaningful classifications along cognitive dimensions.

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I. INTRODUCTION

Within the past decade, there has been a renaissance of psychological interest in cognition. Research in this area can be considered in terms of process, or structure, or both. Process research has included studies of such aspects of cognitive functioning as concept attainment, concept formation, and problem solving. Structural research has focused on the coding and storage of information received or utilized by the organism.

Different degrees of effectiveness of cognitive functioning are assumed to exist at various developmental levels and also for different populations, for example, clinical populations. An important question is whether such differences are qualitative in nature, quantitative in nature, or involve both quantitative and qualitative features.

Interest in human cognitive functioning has had two general objectives: (1) to account for the commonalities found among individuals, and (2) to account for the diversity of cognitive performance found among individuals, even within presumably homogeneous groups. Regarding the former case what is of interest is the observation that, regardless of environmental or situational variability, most subjects in a given natural group, such as an age group, tend to evince a common pattern or type of performance. Regarding the latter, what is of interest is the fact that in spite of commonalities, performances of different subjects are found to differ in certain respects.

If it is assumed that some degree of commonality in cognitive functioning can be found, then a comprehensive theory of cognitive functioning must account for those universals. On the other hand, if the theory is to be comprehensive, it must allow for individual defferences in functioning. It is probably safe to assume that the task of formulating a theory capable of encompassing the entire range of individual differences is beyond the capability of contemporary psychology.

In general, developmental psychology is concerned with changes in behavior over time (Zigler, 1951). In terms of his intellective development, an individual is assumed to function differently as an adult than as a child. Such assumptions are confirmed both by superficial observation and by more rigorous and sophisticated study. The salient developmental questions pertain to the individual's capabilities and actual performance at any given point in the life cycle and to the various contingencies which may influence his current behavior or the subsequent course of his growth.

Several theories, which will be discussed subsequently, have attempted to depict the normal, sequential cognitive growth of children. These theories, in general, focus on developmental trends in the acquisition and utilization of concepts.

It is widely recognized that not all children progress in these areas in a uniform manner. Consequently, many research questions have dealt with the requisite conditions for normal development. Once again, in addition to questions pertaining to the sources of variance in performance, the issue of quantitative versus qualitative differences in functioning is relevant to such issues.

The Problem

The present investigation was based on an analogue theory of cognitive structure and function, developed by

Dunn[1], and was an attempt to extend the theory to the atypical functioning of mentally retarded and emotionally disturbed children. These forms of exceptionality were assumed to be characterized by a maladaptation which could be described in cognitive terms.

The theory was assumed to be capable of generating hypotheses concerning the patterns of functioning characteristic of relatively homogeneous groups. Whether the educational groups represented by the classifications of subjects in the study, i.e., mental retardation and emotional disturbance, could actually be differentiated along cognitive dimensions inherent in the model was considered an important question.

An additional purpose of the study, therefore, was to compare the performances of subjects across groups. It was hoped that such comparisons would suggest meaningful psychological criteria for instructional grouping in schools.

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[1] James A. Dunn, unpublished manuscript; personal communication.

II. THEORY AND HYPOTHESES

Theories of Cognitive Functioning

Theoretical formulations of cognitive functioning have represented diverse views. Some consensus can be found across various theoretical positions, however, concerning the important role attributed to concepts in intellectual development.

The Role of Concepts

The system of concepts that evolves in the course of an individual's interaction with his environment is seen by many writers as enabling the individual to function more effectively. One's conceptual system, according to Harvey, Hunt, and Schroder (1961, pp. 2-3), "...serves as an experiential filter through which impinging events are screened, gauged, and evaluated, a process that determines in large part what responses can and will occur."

Harvey, Hunt, and Schroder stress that the behavior of an individual is the consequence of the conceptual system through which he understands his world. Sigel (1964, p. 209) has referred to concepts as "...crucial links between the environment and the individual..., intellectual tools that man uses in organizing his environment and attacking his problems." Harvey, Hunt, and Schroder (1961, p. 10) have described this function as follows:

> Concepts, in their matrix of interrelatedness, serve the critical cognitive function of providing a system of ordering, by means of which the environment is broken down and organized, it is differentiated and integrated, into its many psychologically relevant facets.

The concepts comprising the system are acquired through interaction with the environment and are organized and stored for subsequent use; thus, concepts both influence and are influenced by experience.

Although an individual's mode of conceptual functioning is dependent to some degree upon the area of experience involved, the developmental progression is generally toward greater abstractness. In the course of development, there is,

> ...an increased availability of alternative concepts or schemata for coping with the same stimuli. Thus, as progressive development occurs, a person orders the world more relativistically and less stereotypically. In other words, he operates more in terms of multiple alternatives (within a more complex and dimensionalized space) rather than in terms of bifurcated black-white categories (Harvey, Hunt, and Schroder, 1961, p. 10).

Central mediating processes, then, may involve this conceptual system.

In Piaget's theory of intellective development, the child's attainment of progressively higher degrees of conceptualization is crucial to adaptation. Even during the earliest phase of development described by Piaget, the sensorimotor phase, this developmental process is in evidence in the kinds of tasks accomplished by the child. Sigel has indicated that, at this level, the child,

> ...attains rudimentary knowledge that is the prototype of concepts---the stuff out of which concepts are made; he establishes a differentiation of himself from objects; he localizes himself in space; he establishes a beginning awareness of cause and effect, of time and space--in part because he has acquired the ability to identify the permanence and substantiality of objects early in this period (1964, pp. 214-215).

Important subsequent developmental phases in the formulation of Piaget involve the child's ability to utilize operational thought in problem solving. According to Bruner (1960, p. 35) an operation is "...a means of getting data about the real world in to the mind and there transforming them so that they can be organized and used selectively in the solution of problems."

Both Piaget and Bruner have attempted to discover the means by which the child is able to internally represent his experiences. In Piaget's view, the use of symbols of one form or another is an important factor:

> Representational thought...through symbolic capacity has the potential for simulaneously grasping, in a single, internal epitome, a whole sweep of separate events. It is a much faster and more mobile device which can recall the past, represent the present, and anticipate the future in one temporally brief, organized act (Flavell, 1963, pp. 151-152).

For Bruner, Goodnow, and Austin (1956), a concept permits an individual to see an object in terms of its identity as a member of a class. They have described conceptualization as categorization via inference, and have observed two general types of categorization; identity categorization and equivalence categorization. Categories could also be classified, they observed, as affective, functional, or formal, and the conceptual dimensions involved may be conjunctive, disjunctive, or relational. Bruner, identified several cognitive strategies, each offering certain advantages under certain circumstances. They were: simultaneous scanning, successive scanning, conservative focusing, and focus gambling.

The five stages in problem solving identified by Gagne (1959) were: (1) Presentation of the stimulus situation; (2) Concept formation; (3) Behavior determination; (4)

Decision making among alternative solutions; and (5) Verification.

Regarding the second of these stages, that of concept formation, Rosenberg (1963) has differentiated two substages--abstraction and generalization--which are equally important in determining the ultimate effectiveness of problem solving behavior. The first involves extracting from the situation a salient dimension; the second involves applying that dimension in such a way as to impose order on a given situation.

Implicit in much of the work discussed thus far is the theme of conceptualization as a major determinant of human behavior. How the individual conceptualizes a situation will influence his actions. This position has also been heavily endorsed by Kelly (1955). In Kelly's terms, the individual "...looks at his world through transparent patterns or templates which he creates and then attempts to fit over the realities of which the world is composed" (pp. 8-9). The personal constructs of an individual are "channelized," i.e., guided, directed, or determinded by the way an individual construes consequences. This view of cognitive structure posits an organized arrangement of bipolar dimensions, arranged as subordinate and superordinate constructs.

Kelly's formulation, emanating from a clinical orientation and focusing on personality determinants, is paralleled by the notion of a conceptual network or framework which acts as an "experiential filter," posited in the theory of Harvey, Hunt, and Schroder.

The preceding suggests the importance of concepts as: (a) components of cognitive structure, and (b) crucial tools in adaptation.

Theories of Cognitive Development

Piaget has viewed intelligence as "...an organizing activity whose functioning extends that of the biological organization while surpassing it due to the elaboration of new structures" (1936, p. 407). The main feature of development, according to Piaget, is the "...continuous creation of increasingly complex forms and a progressive balancing of these forms with the environment" (1936, p. 3).

These forms are called schemata and are considered to evolve in the course of the adaptive interaction of the child with his environment. In the view of Piaget, thought is always based on action, and its growth consists of the elaboration of schemata through the processes of assimilation and accommodation. Assimilation refers to the interpretation of things or events in terms of a schema already present; accommodation refers to the necessity for some change or rearrangement of a schema in order to accommodate an experience. The interplay between these parallel processes is essential for intellectual growth, that is, adaptation. This interplay is directed toward equilibrium. Growth also results in the differentiation of schemata and the concommitant decrease in the child's use of egocentric thought, as a consequence of his attaining multiply-based perspectives on an object or event.

Flavell (1963, p. 53) has defined a schema as "...a cognitive structure which has reference to a class of similar action sequences, these sequences of necessity being strong, bounded totalities in which the constituent behavioral elements are tightly interrelated."

An important feature of Piaget's theory is its view of the progressive growth of intelligence through a sequence of stages which emerge in invariant order. Each stage is characterized by particular forms and modes of thought.

Bruner and his co-workers have indicated areas of disagreement with Piaget with regard to factors affecting cognitive development. To Piaget, they assert, "...cognitive development is seen as almost purely a matter of maturation, maturation that takes place by a process of internalization of logical forms" (Bruner, et al., 1966, p. 214). In their view, however, development "... is conceived more in terms of the internalization of technologies from the culture, language being the most effective technology available." (p. 214). Bruner has stated that cognitive growth "... moves forward in spurts as innovations are adopted, "most of which are "...transmitted to the child in some prototypic form by agents of the culture" (1964, p. 13).

Bruner's conceptualization of stages of development differs, in important respects from that of Piaget. In Bruner's position, greater emphasis is given to the continuity and interaction of different forms of representational thought, in that it,

> ...also stresses the differences in the ways the world can be represented: enactively, ikonically, and symbolically. Although there is a developmental sequence in terms of which--or more properly, how many--of these modes are available to a person, all three remain "in the system" throughout life, and there is always interaction among them (Bruner, et al., 1966, p. 214).

Cognitive growth has been described by Wohlwill (1962) in terms of progression along a continuum from perception to cognition. An experiment describd by Inhelder and Piaget (1964) is of relevance in this connection. When presented with tasks to solve and then asked how they had solved these tasks, the youngest subjects (ages 2 ½ to about 5) described their behavior in terms of figural collections. Older children revealed that they had used a single common characteristic belonging to a set of objects. Ultimately, with oldest subjects, classifications emerged on the basis of multiple characteristics, requiring mastery of what Inhelder and Piaget called the "inclusion relation."

A parallel sequence was reported in performance patterns of children on a conservation experiment by Bruner and Kenny (in Bruner, et al., 1966). Similarly, Sigel (1953), in a study of categorization, found that, with increasing age, children tended less to respond on a perceptual basis and tended more to respond on a conceptual basis.

Another approach to the study of conceptual development is represented in the work of Vigotsky (1962).

Vigotsky identified three basic phases in cognitive development, each of which was subdivided into stages. Concept formation was the final stage, considered to emerge fully by adolescence, although in evidence in embryonic form during earlier periods.

Vigotsky used an object sorting task to analyze the characteristic features of thought associated with each level. In this task, subjects were required to sort twenty-two blocks, varying in several color, form, and size dimensions, into groups. Sequential progression was seen from sorting in "unorganized congeries or 'heaps'," (p. 59), through a period of "thinking in complexes," (p. 61), to the ability to form concepts. The distinction between complexes and concepts was described as follows:

> The principle function of complexes is to establish bonds and relationships. Complex thinking begins the unification of scattered impressions; by organizing discrete elements of experience into groups, it creates a basis for later generalizations" (p. 76)

In concept formation, it is "...necessary to abstract, to view the abstracted elements apart from the totality of the concrete experience in which they are embedded"

(p. 76). Ultimately, "A concept emerges only when the abstracted traits are synthesized anew and the resulting abstract synthesis becomes the main instrument of thought" (p. 78).

Hanfmann and Kasanin (1942), in their use of the Vigotsky object sorting method, also identified three stages, which roughly parallel those of Vigotsky. At the first stage, subjects evidence a categorical attitude in grouping objects according to, e.g., form, rather than considering them as discrete entities. The second stage is characterized by insight into the multiple possibilities of the choice. Finally, at the third stage, consideration of the total system is demonstrated.

Hanfmann and Kasanin (1942, p. 10) have described the advantages of the Vigotsky method:

> ...use of concepts has a definite functional value for the performance required by this test. Whether the subject actually uses conceptual thinking in trying to solve the problem...can be inferred from the nature of the groups he builds and from his procedure in building them. Nearly every step in his reasoning is reflected in his manipulation of the blocks.

The theories of Piaget, Bruner, Vigotsky, and Hanfmann and Kasanin emphasize a sequence of conceptual development which culminates in the emergence of abstraction as a highly efficient cognitive tool.

Werner (1948, p. 234), however, felt there were analogous processes of abstraction which could be seen at every level, not just the last one. He identified these levels as the level of bodily cues, the level of concrete perceptual relationships, and the level of conceptual activity. In this respect, his view was not unlike that of Piaget. Abstraction at the first and second levels was considered to be a mode of thought that "... is simply logical in another, self-contained sense" (p. 16). Werner felt there were parallels between the thinking of children and that of primitive man:

> Among primitive peoples, and also children, there is found a kind of thinking which, with great justification, may be termed 'concrete' thinking. Its distinctive characteristic lies in the fact that the conceptual activity operates in indivisible unity with motor-perceptual and imaginative processes. It is only gradually that a non-sensori-motor--that is, abstract--mode of thinking separates itself from this unity (p. 52).

According to Werner, the function of thought is that of a mediator, regulator, and organizer of subsidiary processes.

Werner posited five principles of development, the first of which he termed the Orthogenetic Law. According to this principle, development proceeds from global perceptions toward increasing differentiation, that is, away from "syncretic" thinking. Associated with this increased differentiation is an increased ability to think hierarchically, i.e., to subordinate, and to integrate.

Intelligence tests generally approach the description of a child's intellective ability in simple quantitative terms. It is felt, however, that the views summarized in the preceding pages suggest an alternative, qualitative, means by which a child's level of intellectual ability may be described.

The Theoretical Framework of The Present Study: Cognitive Matrix Theory

The present investigation was carried out within the context of an analog theory of cognitive development and cognitive functioning. Dunn's matrix theory uses a physical analog model to represent the organization of information within an individual's cognitive structure. In this model, reference points in hyperspace form conceptual classification dimensions which may in turn, be grouped into superordinate regions.

Thus, concepts are represented as associated points in space, and the associations, or linkages, between particular pairs of points represent conceptual or classificatory dimensions, the two points being the poles of the dimension. Points which are located in a particular region of the cognitive structure presumably have maximal relationship. A point may be associated with points located in other, more distant, regions, however.

This network of associated and grouped points in space comprises a cognitive matrix, which is assumed to be continuously changing. New associations are made, new content is added, and new dimensions are formed as needed, or as demanded by experience. The variables affecting the size and nature of the matrix are the extent and utility of the matrix at any given point in time and also the experiences to which the individual is exposed in the course of his interaction with the environment.

The model is dynamic in that it allows for continuous alteration in the size of the cognitive structure, that is, in the number of concepts present. Such alteration can be achieved by expansion, through the introduction of new elements, or through further differentiation and reintegration.

of those elements already present. These growth mechanisms correspond to the processes of assimilation and accommodation in Piaget's formulation. Alteration in the structure can also be achieved, however, by contraction of the matrix, through the consolidation of elements or through extinction.

The observations and theory of Piaget, therefore can be interpreted in terms of cognitive matrix theory. Similarly, the model can reflect developmental levels of conceptual attainment, in terms of the extensity of the cognitive matrix of an individual. The degree of conceptual sophistication is reflected in the nature of the dimensionalities, that is, in terms of the elements, or points, which are associated in order to form conceptual dimensions.

The structural organization of information is only one aspect of the model, however. Of particular importance in performing operations are the conditions for information retrieval.

The model specifies conditions for accessibility of concepts. Although regional proximity may be important, topographical distance is not equated with functional distance. The latter is defined in terms of the number of operations, or steps, required in data processing, the amount of resistance encountered at each step, and the amount of energy which is available. Thus, not only concept accessibility, but also such phenomena of cognitive functioning as remote associations (Mednick, 1962) and cognitive fluency and flexibility (Guilford, 1959; Torrance, 1960) may be viewed in connection with the theory.

The idea of cognitive matrix is related to information theories in that it is concerned with the data-processing aspects of cognitive functioning, especially with regard to storage arrangement and information retrieval.

Unlike information theory, however, it is developmental in orientation. That is, matrix theory also specifies the conditions for acquisition of information and the changes in this aspect of the system in the course of development.

Kelly's representation of conceptual dimensions as polarities is of relevance to the model, as are his notions of subordinate and superordinate constructs and the adaptive value of orthogonal resolutions to conflictive dichotomous dimensions.

Although Sullivan has not usually been viewed as a cognitive theorist, his description of the growth of the self-concept and other-concept is likewise relevant.

According to Sullivan (1953) the infant first forms a concept of me - not-me; the latter becomes differentiated as good-breast - bad-breast, which in turn affects a differentiation of the former as good-me - bad-me. In Sullivan's view, the infant's construction of himself and his world is largely dependent on the formulation of dichotomous conceptual dimensions, the differentiation of concepts, the acquisition of new concepts in relationship to those already present, and the re-integration of concepts in the formation of new dimensions.

Considerable discussion is subsequently devoted to various notions relating to style of conceptualization. The physical structure model can be seen as focusing on individual differences in functioning, based on individual differences in the number and nature of concepts, which in turn affects the number and the nature of dimensions present. An additional important consideration relates to the characteristics of the linkages which associate concepts within the cognitive matrix.

Also, the various factors affecting time required in data processing for concept utilization in performance can be viewed in connection with personality variables involved.

Kagan (1965) has described differences in "conceptual tempo" in terms of a dimension of impulsivity versus reflectiveness.

Extension of the Theory and General Hypotheses

Observation of special populations of children, such as those who have been classified as emotionally disturbed or as intellectually limited, reveals varying degrees of child success in environmental-social adaptation. Piaget's notion of adaptation, the ability to interact with the environment in such a way as insure survival and to promote the well-being of the ganism, requires the child to assimilate new experienc or to accommodate to them. In terms of Dunn's model the cognitive matrix, the child must have at his d posal the concepts necessary in order to assimilate the w element, or he must be able to effect a structural re-a angement permitting the acquisition of the new element.

Children who have been regarded as highl creative may be those with unusually effective potentia ties for adaptation. They can process information via mote associations (Mednick, 1962) of elements withi the matrix, or relate novel ideas to common stimuli (Guilf d, 1950;

Torrance, 1960). Such children may be conceptualized as having a highly flexible cognitive matrix. Their thinking, and often their social behavior, may at times be non-conforming as a consequence, however, and frequently idiosyncratic. Nevertheless, problem solving ability, productivity, and achievement often appear to be enhanced (Getzels and Jackson, 1962).

While the cognitive structure of the very creative child could be larger than that of a less creative peer, it most certainly would be characterized by more complex conceptual linkages. Futhermore, rather than simple stereotyped linkages, these associations may be quite unique and not bound by consensual limitations. This child can entertain highly novel hypotheses, if he desires, but he has the freedom to use this ability as he chooses.

The emotionally maladjusted child, on the other hand, has been described as lacking "degrees of freedom" (Bower, 1965, 1966). In the terms of ego psychology, important ego functions and ego organization are impaired. Although in some respects his thinking may resemble that of the creative child, his "remote associations" are, presumably, less valid. His ideas are frequently too egocentric and idiosyncratic to be of much long range survival value. When confronted by a task, he may be able to do no more than refer randomly to his cognitive matrix, neither able to assimilate nor accommodate to the experience. While the emotionally disturbed child's concept repertoire--i.e., his cognitive matrix--may be no smaller than that of the normal child, it may often be much more loosely or unusually connected, so that his ability to adapt to the environment is uncertain and inconsistent.

Within this conceptual framework, the cognitive matrix of the child regarded as mentally retarded may also be viewed as inadequately developed. However, in this case the differences between the cognitive structures of a normal and of a retarded child may be primarily quantitative, rather than qualitative, in nature. Adaptation may be impaired because of the limited complexity and extensiveness of the relational connections within the matrix; that is, fewer linkages and fewer elements are present. In other words, fewer experiences have been assimilated and the linkages are relatively simple and direct. Each new experience requires an accommodation on the part of the retarded child, involving a new orientation and structural rearrangement.

The position which has been described above suggests several hypotheses, which will be cast in operational terms. They are: (1) There are no differences between normal and emotionally disturbed children in size of the cognitive matrix, but (2) There are qualitative differences in the nature of the relationships represented; (3) There are differences between normal and mentally retarded children in size of the cognitive matrix, but (4) There are no qualitative differences in the nature of the relationships represented.

Such a position reflects the assumption that both emotionally disturbed and mentally retarded children can be viewed as possessing impaired or limited adaptive ability. In each case, the cognitive matrix lacks the survival utility which characterizes that of the normal child. In one instance, the difference is expected to be quantitative, and in the other it is expected to be qualitative.

If these groups are found to differ from each other and from the normal population in the organizational and functional nature of their cognitive structures, specific predictions can be made concerning their conceptual performance and theoretical remediation and/or behavioral modification techniques can be considered.

III. INTELLECTIVE FACTORS IN COGNITIVE FUNCTIONING AND CHARACTERISTICS ASSOCIATED WITH MENTAL RETARDATION

The importance of subject variables, that is, certain characteristics which differentiate some subjects from others, has been increasingly recognized in psychological research. Atkinson (1964, p. 276) has stressed "... the general need of psychology to bring about an integration of the study of individual differences and basic behavioral processes." As Hovland (1960, p. 632) has noted, "...every worker in the field is struck by the wide variability from individual to individual in even the simplest types of learning."

Perhaps the two most obvious types of subject variables are age and sex. The relationships between chronological age and conceptual performance would seem superficially obvious. Presumably, older individuals, if consideration is restricted to children and other relevant variables are controlled, have access to more information and manifest a more highly developed conceptual system than do younger individuals. Such observations, in fact, have formed the basis for the original validation of intelligence tests (see, for example, Terman and Merrill, 1960). The relationship between sex and conceptual performance may be less obvious. Some studies, (e.g., Terman, 1947) have noted the differential growth trends in measured IQ for males and for females. Kagan (1964) and Kagan and Moss (1962) have discussed the influences of culturally imposed sex role standards on cognitive functioning.

Cognitive Functioning in Mental Retardation

In the field of education, it has been axiomatic that individuals of the same age may differ with respect to their ability to learn. Hovland (1960) noted that experimental studies of various kinds had typically tended to show high correlations between mental age (MA) and learning scores. However, citing a number of such studies, he concluded that no decisive evidence of a generalized learning ability had as yet been obtained. The definition of intelligence as a generalized "ability to learn" could be challenged, he observed, on the basis of this lack of experimental evidence.

Sigel (1964) concluded that, although the usual measures of mental ability do not reflect the crucial aspects of or requisites for concept attainment in children, research with the mentally retarded has generally suggested that the level of conceptualization is affected by the degree of retardation. Sigel noted, however, the common observation of great variability within IQ categories of retardates on cognitive tasks and concluded that an important goal of research in mental retardation should be to specifically identify the deficits in concept learning and the cognitive processes involved in these deficits.

Ellis (1963) has asserted that IQ, and consequently MA, are low-order explanatory variables.

In reviewing research on problem solving, Rosenberg (1963) observed that only the more recent studies had focused on process. Of the two general classes of study design, comparative and experimental, most research with retardates had been of the former type rather than the latter. According to Rosenberg, the chief task for research should be to identify the variables which facilitate or interfere with problem solving and conceptual behavior. Such identification would require the experimental manipulation of some variable.

Some studies have suggested that subjects differing widely with respect to MA may learn in different ways.

White (1963) cited studies suggesting that younger and duller children may learn more gradually than those of higher chronological or mental age. This may enable the retarded individual to perform more accurately, and in some cases more efficiently, on some learning tasks.

Many studies have investigated the role of verbal mediation in the cognitive performances of subjects of differing MA. Sanders, Ross, and Heal (1965) found that observed differences in the learning processes of normal children and retardates were evidenced by the universal use of mediational processes among the former in contrast to the latter. Thus, in their study, reversal shifts were easier for normal subjects than were nonreversal shifts. The research of Kendler and Kendler (e.g., 1959, 1961) has stressed the role of mediational processes in explaining differential performances on tasks of transposition learning. Zeaman and House (e.g., 1958), on the other hand, have explained differential performances of normals and retardates on transposition learning tasks on the basis of differential attentional processes.

A study which focused on the role of verbal mediation in children's conceptual sorting of objects was conducted by Carey and Goss (1957). Eight blocks were presented to four groups of four and five year old children. The blocks varied in size and in height and represented dimensional combinations of these attributes. One group of subjects was given a familiar word label to learn in association with the blocks prior to being asked to sort them. A second group learned a nonsense syllable, the third was given no label but merely allowed to see the blocks prior to being asked to sort them, and the fourth was given no prior exposure. Subjects were then asked to sort the blocks into four categories in terms of height and size. Labeling with a familiar word was found to effect positive transfer to sorting as evidenced by faster learning of the correct sorts. However, Hermelin and O'Connor (1957) found pretraining on verbal mediators unrelated to responses of imbeciles to common characteristics of objects.

As Rosenberg (1963) has noted, in studies involving simple and double alternation problem solving tasks, successful performance has correlated well with MA, although often retardates who respond correctly on the task are unable to provide a verbal rationale for their behavior.

Rosenberg (1963, p. 459) concluded that, "... under certain conditions some mental defectives are capable of problem-solving, abstract learning, abstract performance, and generalization despite evidence of an inability to identify verbally the relevant dimensions of similarity."

Also pertaining to the relationship of language to conceptual behavior of retardates was a study conducted by Griffith, Spitz, and Lipman (1959). The findings of this study suggested that differential concept formation performance between normal and retarded subjects could be accounted for on the basis of a mediational hypothesis. Other work by Griffith and his associates (e.g., Griffith and Spitz, 1958; Griffith, 1960) has been concerned with the relationship between a subject's ability to abstract a common property from a verbal triad and his ability to define the words in the triad.

Another approach to the study of cognitive deficits associated with mental retardation has been directed toward the investigation of perceptual processes. Spitz and his associates (Lipman and Spitz, 1961; Hoats, Miller, and Spitz, 1963; Spitz, 1964) have conducted research focusing on the phenomenon of rigidity in retardates.

Their approach, unlike that of Kounin (1941) or Stevenson and Zigler (1957), culminated in a physiochemical theory of "cellular torpidity." Spitz and his associates have employed such illusions as the visual figural aftereffect and the Necker Cube illusion in testing the hypotheses generated by the theory.

The abstract - concrete dichotomy in the formulation of Goldstein and Scheerer (1941) has generated a large number of studies involving retardates. According to the theory, both response tendencies, abstract and concrete, are present in normal individuals, but only the concrete is present in such abnormal conditions as schizophrenia and brain injury. The abstract attitude is reflected in the ability to consciously respond to common properties of objects and events which are otherwise dissimilar, and to shift response from one dimension of similarity to another. The concrete individual, on the other hand, is unaware of common properties of objects and events and is therefore unable to respond to them.

According to Rosenberg (1963), the research which has been conducted with retardates in terms of the theory has been entirely dichotomous, concerning the question of whether retardates are concrete in their con tual behavior. However, in their original formulat , Goldstein and Scheerer (1941, p. 8) referred to "... v ous degrees of abstract behavior corresponding to the de e of ideational complexity which the performance in q tion involves." The maximal utilization of abstr think-ing, in their view, "...is required for the scious and volitional acts of forming generalizations a hierarchic concepts or of thinking in terms of a princi and verbalizing the acts" (1941, p. 8).

Indices of abstract or concrete concep l behavior were obtained via examination of subjects' p ormance on five tests. A brief description of each t follows.

1. The Goldstein-Scheerer Cube Test

   The cubes used in this test were ur small Kohs blocks, each surface of h block either a single solid color o wo colors diagonally divided. S was f t given the Ishihara Color Test, then asked to name the colors on the blo . Next, E named the colors and asked o copy the designs formed by juxtapos on of the blocks. Concrete Ss employe o analytical reasoning, but "...respo unreflect ngly to the task of 'copy ..." (1941, p. 32).

2. The Gelb-Goldstein Color Sorting Te

   In this test, the subject's task s to sort wool skeins differing in h The critical question was S's abili to employ color concepts, specifically the c pt of hue, in sorting.

3. *The Gelb-Goldstein-Weigl-Scheerer Test*

   Two sets of varying objects were employed in this test, one set for male *S*s and one for females. Administration of the test involved five specific experiments: the grouping of articles relating to the choices of *S* and *E*; arranging all the articles into separate groups; choosing another way of grouping the articles; asking *S* why a grouping performed by *E* was appropriate; and a control experiment for the questioning procedure.

4. *The Weigl-Goldstein-Scheerer Color Form Sorting Test*

   In this test, *S* was presented with twelve figures, including squares, triangles, and circles, and differing in color. *S* was asked to sort the figures in one way and then to shift to another way and provide an explanation for the new arrangement. *S*s using the abstract approach were those who approached the task in terms of a category either of color or of form. Concrete *S*s tended to treat the figures as individual things rather than as members of a class.

5. *The Goldstein-Scheerer Stick Test*

   In this test, the *S* was first asked to copy stick figures, and then to reproduce them from memory. One of the advantages of this test, in the view of the authors, was the fact that, "They are abstract features in an abstract geometrical space, bearing no direct reference to a tangible life situation" (1941, P. 12).

The Goldstein-Scheerer formulation, despite its apparent heuristic merits, has been subject to criticism. Weatherwax and Benoit (1957) criticized what Rosenberg referred to as the "... questionable validity of the underlying theory which insists upon a dichotomization of abstract and concrete and the necessity for conscious awareness of relevant conceptual dimensions as the _sine qua non_ of abstract behavior" (1963, p. 454). This criticism is related to the observation of Rosenberg, cited earlier, that in many kinds of tasks retardates often appear to utilize abstraction despite the inability to identify verbally the basis for their behavior.

The tests described above have been employed by Halpin (1958) and by Halpin and Patterson (1954) in studies with retardates. In the former study, with a large sample of retarded children, aged seven through fourteen, Halpin found that neither color nor form preference was related either to CA or MA, nor were pattern responses. Impairment in category shifting ability was found to decrease significantly as a function of increasing CA. Halpin and Patterson matched brain-injured and familial retardates on both MA (range = 4 - 7) and CA (range = 9 ½ - 13 ½). No significant differences were found between the groups in the initial principle used in sorting or in the ability to shift the principle for sorting. The only significant difference pertained to the production of patterns during sorting, with a greater proportion of familials producing patterns.

The tendency of retarded child subjects to employ position reversal rather than dimension reversal on an experimental task was reported by Milgram and Furth (1964).

Stephens (1966) found retarded subjects inferior to normals matched on CA in using categories provided for the grouping of materials, as well as in identifying the categories they already had used successfully.

Inferior performance of retarded subjects as compared with normals was reported by Siegel (1957) in a study involving the administration of the Visual-Verbal Concept Formation Test to both groups. Retarded subjects were specifically impaired in their ability to shift the basis of selection of pictured stimuli from one relevant dimension of similarity to another, and also in the ability to verbalize the relevant dimensions of similarity.

The notion of an abstract - concrete dichotomy was initially formulated in terms of abnormal conditions such as brain injury. That the conceptual performance of retardates could also be characterized as concrete was considered secondarily. A number of theoretical positions and research approaches have posited similarity or difference between brain-injured and retarded individuals in term of their respective characteristics of cognitive functioning.

One such position was that of Strauss and Werner (1942), who found that brain-damaged child subjects tended to sort objects in an idiosyncratic manner and to offer far-fetched explanations for their groupings. In addition, these subjects often revealed an inability to refrain from attending to irrelevant features of the objects when sorting. When presented with a collection of fifty-six objects, brain-injured subjects used more objects and made more groupings than did familial retardates in an experiment conducted by Strauss and Werner. Although verbal explanation of groupings were predominantly functional in both groups, those offerred by brain-injured *S*s were typically more bizarre and, in contrast to the familial group, were sometimes both bizarre and non-functional.

McMurray (1954) compared the performances of exogenous and endogenous retardates on a modified version of the Wisconsin Card Sorting Task, a measure of certain aspects of conceptual behavior. In this task, a series of cards, containing items varying in color, form, and number, was presented. Nonverbal abstract performance and the ability to shift dimensions in recognizing similarities were measured. Non-brain-injured subjects were found to perform better on all indices, making fewer perseverative sorting errors and requiring less time and fewer trials to reach criterion.

Similar findings were reported by Barnett, Ellis, and Pryer (1960), who compared the performances of MA- and CA- matched brain-injured and familial retardates on a double alternation task. Brain-injured subjects required significantly more trials to reach criterion in learning the double alternation problem.

The view that endogenous and exogenous retardates differ significantly in cognitive functioning, or respond differently to particular educative approaches, has been questioned on the basis of findings of several studies, in particular the research of Gallagher (1957). According to Gallagher (1960), it is difficult to ascertain to what extent brain injury affects the higher mental processes. The relationship of brain injury to cognitive processes, he asserted, is found in its characteristic effects on perception which in turn inhibits concept formation. Gallagher reported substantial within-group variance, and considerable variation in the effects of brain damage. These effects, he suggested, are dependent upon such factors as localization, severity, type, chronicity, and age at onset.

The presence of organic brain injury has often been found to pose a difficult diagnostic problem (see, for example, Cruickshank, 1961). Halstead (1947), whose diagnostic procedures involved administration of a battery of tests, pioneered in the use of particular task indices as indicators of the locus and effects of brain injury. Halstead's battery included, among other tasks, a measure of conceptualization involving block sorting. The work of Reitan (1955; 1959) has represented even more intensive efforts to predict locus, type, and severity of organic brain damage on the basis of indices including performance on concept formation tasks.

It would appear evident from much of the research in mental retardation cited thus far that the issue of basic differences between groups, such as normal versus retarded, endogenous versus exogenous, etc., has been an important one. Zigler (1966), however, has criticized what he termed the "difference orientation" in work with retardation, and has stressed the lack of consistent research evidence in support of any of the propsed "differences," at least for familial retardates.

The work of Zigler and his co-workers (Stevenson and Zigler, 1957; Zigler, Hodgden, and Stevenson, 1958; Zigler, 1961; Green and Zigler, 1963; etc.) has consistently stressed the motivational implications of retardation itself, and of the environmental conditions most frequently associated with retardation. Zigler (1963) has urged that the possible adverse effects of deprivation of social reinforcement in the histories of many retardates be thoroughly investigated.

The view that mental retardation is not a unitary syndrome with which certain forms of cognitive behavior are invariably associated has been expressed by workers such as Kessler (1966, pp. 89-90) and Heber (1964, p. 169).

Problems encountered in determining the intellective aspects of mental retardation may represent one aspect of the broader problems of the nature and measurement of intelligence itself, according to Zigler (1966). He has suggested the possible merits of "... reorienting or restructuring our approach to intellectual retardation" to a "concern with cognitive processes" (1966, p. 113).

Laurendeau and Pinard (1962) have noted that Piagetian tasks, in contrast to the usual intelligence tests, permit investigation of the cognitive processes in operation which produce the score or result. Using Piaget's questions designed to assess the child's developing concepts of causality, Laurendeau and Pinard have constructed a standardized test. They have observed a decrease in children's responses indicating precausal thinking as a function of CA. Mary Woodward, whose research with severely deficient institutionalized retardates has involved the use of Piagetian tasks, has also stated that such tasks permit examination and evaluation of process rather than simply outcome (1963).

The possibilities for the application of stage-attainment aspects of Piaget's theory to retardation has been suggested by Inhelder (1944), who felt that these stages could be used as a new means of classifying grades of mental deficiency. The experiment used by Inhelder in placing subjects on a developmental scale suggested to Hunt (1960, p. 260) the possibility of a "... natural ordinal scale of conceptualization and intelligence." The experiment was designed to determine the existence in subjects of conservation of quantity, weight, and volume. Inhelder found that every subject who showed conservation of volume also showed conservation of weight and quantity, and each subject who showed conservation of weight also showed conservation of quantity, thus confirming the Piagetian stage hypothesis.

An example of Woodward's applications to the assessment of conceptual development in retardates was a study with institutionalized defectives, all of whom failed to reach the basal level (age two) on the Stanford - Binet Intelligence Scale. Using Piaget's sensorimotor stages, Woodward compared the stages reached by subjects in problem solving with stages reached in the development of a concept of object permanence. Correspondence between these indices was found in eighty-seven per cent of the sample in her study. A high degree of correspondence was also found when subjects were classified according to the stage sequence in terms of evidences of primary, secondary, and tertiary circular reactions, and compared to their stage level of sensorimotor intelligence.

Woodward (1959) also observed that bizarre manneristic behavior, such as hand movements, among severe defectives were similar to those of infants aged two and three months. She concluded that these mannerisms originated in both instances in the course of coordinating vision and grasping schemata, as Piaget had described in connection with early sensorimotor development.

In summarizing attempts to apply Piagetian stage theory to the study of mental retardation, Sigel (1964,

p. 212) concluded that the studies which had been conducted "... indicate that the order of the stages is present but appears at different chronological periods, and that the rate of change varies from that of normal children."

Goldman and Levine (1963) used several object sorting tasks, including the Weigl-Goldstein-Scheerer Test in attempting to apply Werner's developmental hypotheses to the sorting behavior of a large sample of child and adult subjects. In particular, they examined the hypothesis of a developmental sequence from global perceptions, to gradual differentiation or individuation, to the ultimate hierarchical integration of object clusters. Goldman and Levine found developmental trends indicating steady decrease in sorting on the basis of global perceptual features and concommitant increase in differentiation of dimensions. Early categorizations were observed to be based upon perceptual features and the personal experiences of the subject, with designative class categorizations emerging later and eventually exceeding the former.

Another aspect of developmental progression in conceptualization in sorting relates to dimensional preferences, i.e., the tendency for children at particular developmental levels to use a dimension such as form or color exclusively or most typically as a basis for grouping stimulus materials into categories. A number of studies (e.g., Brian and Goodenough, 1929; Colby and Robertson, 1942; Reichard, Schneider, and Rapaport, 1944; Honkavaara, 1958; and Kagan and Lemkin, 1961) have followed the early investigation of this problem by Descoudres (cited by Werner, 1948). These studies have generally concurred in the finding that form is a more predominant basis for children's object sorting than is color or are other dimensions. Also, with some discrepant findings, they have concurred in the conclusion that it emerges earlier in development as a mode of conceptualization.

To assess the development of conceptualization in children, Vigotsky (1962) employed an experimental task which involved twenty-two blocks in order to test hypotheses generated by his theory (supra, pp. 13-15). These blocks varied in color, shape, height, and size. Each block was labeled on the bottom with a nonsense syllable, and subjects were asked to sort the objects into groups. Vygotsky reported specific features of conceptual behavior associated with various sequential levels of cognitive development.

The relationship between performance on the Vigotsky task and MA was explored by Meece and Rosenblum (1965), who administered the task to fifty sixth grade girls. The subjects ranged in MA from eight to fourteen. Of forty-five task indices of level of conceptual thinking nearly half were found to be positively correlated with MA. Those indices which seemed to be most closely associated with mental age were those relating to subjects' ability to verbalize the conceptual basis for sorting.

Summary

A more or less traditional view of mental retardation in children is the notion of a lag in development. That is, intellective development, for one reason or another, is thought to have progressed more slowly than that of the normal child.

However, as was discussed in the preceding pages, some approaches to the study of retardation have attempted to identify certain cognitive processes and/or personality factors which might account for impaired functioning. Similarly, attempts at associating degree of retardation with characteristic patterns or types of cognitive behavior have been made.

In discussing a number of theoretical positions and research findings, the attempt was made to mention several general or specific conceptual characteristics which have been posited with respect to the cognitive functioning of retardates. These have included such characteristics as: retardation in the acquisition rate of important pivotal concepts, such as those concepts associated with conservation; the inability to abstract, or to conceptualize in terms of abstractions; the inability to use language effectively in performing abstract tasks;

difficulty in shifting from one conceptual orientation to another; slowness in responding or attending; short-term memory deficit; and specific perceptual deficits of various kinds.

It would be impossible to simultaneously test all hypotheses which could be generated in terms of the above considerations, or to control for all those considerations not being specifically tested. An appropriate approach, however, would be one in which particular cognitive operations required in the performance of a task could be observed and quantified, and compared in several respects with the operations of normal children of the same age on the same task.

In the present study, through examination and comparison of specific aspects of task performance, an attempt was made to interpret the conceptual behavior of a group of children classified as mentally retarded in terms of a model of cognitive structure. The literature reviewed in this section, although not conclusively warranting such an assumption, suggested that the cognitive functioning of retarded children differs from that of normal children. On the basis of various findings, several hypotheses regarding the cognitive functioning of retarded children were stated in terms of a theory of cognitive structure. Some of these hypotheses pertained to similarities between the cognitive functioning of retarded and normal children, and some pertained to differences between these groups.

Important considerations in the formulations of the hypotheses to be tested in this study included such questions as: (1) Whether conceptual dimensions are used in categorization; (2) Which dimensions are used and in what order they are used; (3) Whether the subject is aware of and can state the basis for categorization; (4) Whether the subject can switch from one relevant dimension of conceptualization to another; (5) Whether categorization is usually based on isolated perceptual features, or on functional attributes, of individual objects; (6) Whether reaction time becomes slower as more sophisticated dimensions are used; and (7) Whether the subject is able to consider objects in terms in which he himself is not involved.

IV. EMOTIONAL FACTORS IN COGNITIVE FUNCTIONING AND CHARACTERISTICS ASSOCIATED WITH EMOTIONAL DISTURBANCE

Interactions of Cognitive and Personality Factors

Certain observations of workers in areas of child development and of measurement (e.g., Liverant,1960; Zigler, 1963) have suggested that personality variables may often play an important role in the determination of cognitive or intellective behavior. A number of attempts have been made to identify particular aspects of these cognitive - personality interactions in order to gain a better understanding of their possible relationship to the behavior observed.

Prior to reviewing the work which has been reported in connection with the cognitive functioning of emotionally disturbed children, it seemed important to devote some discussion to related work on cognitive - affective interactions. It was assumed that such interactions as these might provide a basis for understanding the disturbed cognitive behavior of clinically identified groups of children. In the discussion which follows, some views are presented in connection with the significance of various modes of conceptualization and also in connection with varying degrees of adaptive utility of certain conceptual characteristics.

The term cognitive style was coined by Gardner (1953). In studying the behavior of subjects in categorizing tasks, Gardner observed that,

> ...some persons seem constantly to be 'honeycombing' stimuli into small compartments, as if this were for them an especially important mode of coming to terms with the world about them. Others seem most comfortable with more unobtrusive categorization (p. 215).

Individuals evincing the latter style were termed levelers, and those of the former type were termed sharpeners. Gardner observed that individuals appeared to differ in the span of items or characteristics they were willing to include under one conceptual rubric, that is, within what he called an equivalence range.

Somewhat related to Gardner's conception of the equivalence range was a dimension investigated in a study by Pettigrew (1958). The dimension was termed category width, and subjects were classified as broad, medium, or narrow in terms of this dimension. Subjects were asked to estimate the extremes of a number of diverse categories, and were found to demonstrate a significant tendency to be consistent across topics with respect to category width.

Witkin and his associates (1954) noted consistent patterns in the performance of individuals on tasks involving perceptual judgments, and developed an approach using these judgments as indicators of personality orientation. The classifications of field dependence and field independence were determined by subjects' performances on certain tests of perceptual judgment.

In the formulation of Witkin and his associates, field dependent individuals were thought to react globally to situations, having difficulty in separating out units within the stimulus field. Field dependence and field independence were observed to generalize across tasks and to apply even to subjects' behavior in social situations.

Subsequently, Witkin (1962) suggested a developmental sequence from global perception to a greater capacity for analytical perception and articulation, i.e., a trend toward increasing differentiation. In this conception, the experiences of an individual were considered very influential in determining the extent of his progressive differentiation.

Field dependence was viewed as a generally passive, rather than active, mode of organizing experience. Among the implications of the position taken by Witkin and his co-workers was the expectation that field independent subjects would perform better in memory tasks, which Witkin (1962) tested and confirmed.

Other observed or implied correlates of field dependence, which are relevant to the present investigation, were: poorer performance under stress conditions; greater susceptibility to psychopathology; use of primitive defense mechanisms; and generally greater susceptibility to affective interference in judgment and cognitive functioning.

Podell (1958) employed verbal instructions to adult subjects to induce a set appropriate to either the utilization of hypothesis-testing strategies or a summation process. This study might suggest the possibility that, under certain circumstances, certain aspects of style of conceptualization may be experimentally induced.

Kagan, Moss, and Sigel (1960, p. 261) observed individual differences in the "...preferred mode of organizing and labeling stimuli," or in what they called "conceptual style."

Kagan, Moss, and Sigel (1963) subsequently reported the emergence of what they then considered to be two basic orientations in conceptual behavior, egocentric and stimulus centered. The egocentric orientation was characterized by "... the individual, personalized, affective classification of a group of stimuli and/or the inclusion of the individual as part of the grouped stimuli" (p. 263). Within each orientation, classifications could be descriptive, categorical-inferential, or relational. A further differentiation was made in that classes could have either a substantive or denotative meaning.

Kagan, Moss, and Sigel found sixth grade children to be consistent across tasks in terms of conceptual style. Subjects used either (1) an analytic-descriptive style, characterized by the tendency to see similar parts in two or more objects and to use this as a mode of classification; (2) an inferential-categorical style, characterized by the tendency to draw inferences about separate elements considered together; or (3) a relational style, in which subjects conceptualized in terms of functional relationships between objects.

Sigel (1963) has since formulated a theory of style of conceptualization. In his view, an individual acquires a preferred mode of attending to and organizing various features of his environment. The set of labels employed by an individual in processing experiential information is important in Sigel's formulation. Hence, language plays a crucial role both as a determiner and a manifestation of conceptual style.

Sigel classified labeling styles as descriptive, relational-contextual, and categorical-inferential. He has found age trends and consistent sex differences in subjects' preferred mode of labeling, as well as significant correlations between conceptual style and intelligence test scores (1963).

Preferred modes of conceptualization may involve preference for particular stimulus dimensions. Suchman and Trabasso (1966) studied the effects of preference for form or color on concept attainment in young children. Such preferences were reported to influence both order and accuracy of concept learning.

Witkin and his associates (1962) investigated the effects of particular patterns of mother-child interaction, and the characteristics of mothers as individuals in terms of field dependence or field independence. Maternal characteristics were reported to be associated with predicted patterns of mother-child interaction, and both were associated with the level of differentiation evinced by the child in perceptual-cognitive task performance.

Hess and Shipman (1965) reported differences in maternal teaching style and the sorting of common objects by their four year old children among mothers of varying socioeconomic class levels. The differentiating variables were interpreted as reflecting differences in linguistic codes associated with socioeconomic class status, and were identified as an elaborated and person-oriented versus a restrictive and status-oriented linguistic code. These differences appeared to be associated with children's ability to perform conceptual sorts and to provide effective verbal explanations of the basis for their sorting on the categorization task.

Kagan (1965) has reported findings regarding a "decision time" variable in children's performance, involving a dimension of _reflection_ versus _impulsivity_ based on conceptual tempo. He has described children's conceptual tempo to be consistent across tasks and related to fundamental personality organization. Earlier, Kagan and his associates (Kagan, Rosman, Day, Albert, and Phillips, 1964) had explored impulsivity as one of two dimensions of conceptual style, the other termed _analytic-reflective_. Placement of subjects along these dimensions was determined by performances on a Design Recall Test, a Hidden Figures Test, and a Conceptual Style Test.

The impulsivity variables yielded by measures such as the Matching Familiar Figures test was found to be correlated to recognition errors in reading. Task errors and reading recognition errors made by impulsive subjects were "errors of intrusion," i.e., errors of commission rather than omission.

In analyzing such results, Kagan has suggested the possible role of societal pressures on the child. One such social standard places a premium on speedy performance, the other on accuracy, and these are of particular salience to the child within the context of school. He described the impulsive child as possibly one who places a higher value on quick success and has a high-risk orientation (1965). However, Kagan has considered the possibility that constitutional factors may have some role, and recent work (Kagan, 1966) has been directed toward this question.

Getzels and Jackson (1962) compared subjects with above average or superior IQ who scored high on a battery of test of creative thinking with equally high-IQ but low-creativity subjects. These tests were scored in terms of the dimensions of originality, flexibility, and fluency. Although the two groups were about equal in academic achievement, the high-creative subjects were typically less well-liked by teachers, less socially-oriented, and less dependent upon peer acceptance and teacher approval.

Gallagher (1966) has suggested a parallel between the high-IQ versus high-creativity dimension and the dimension of field dependence versus field independence, as well as the personality-based dimensions of expressiveness versus defensiveness (Maslow, 1956) and allocentricity versus autocentricity (Schactel, 1959).

The structure of intellect model of Guilford (1950) has given impetus to much research in the area of creative thinking. In particular, Guilford's distinction between convergent and divergent thinking has been considered to suggest the influence of personality variables on cognitive performance. The results obtained by Getzels and Jackson suggest the operation of divergent thinking along dimensions associated with creativity. Regarding the relationship between divergent thinking and creativity, Guilford (1950, p. 160) has said, "We might arbitrarily define creative thinking as divergent thinking, but it would be incorrect to say that divergent thinking accounts for all the intellectual components of creative production." Guilford (1959) has investigated the role of motivational factors and factors of temperament which might or might not be associated with creativity. He found no support for the notion that originality is dependent upon unconventionality in social behavior. Expressional and ideational fuency, quantitative indices of productive thought, were found to be associated with impulsiveness, but not with general activity level.

Torrance (1965a) has described the possible role of modes of thinking, such as convergent and divergent thinking, evaluation, and others, in determining the resistance of an individual to stress and also his recovery strength. High correlations with performance on the creativity test battery of such personality variables as ego strength, positive self concept, humor, and ease of recall of early life experiences have also been reported (Torrance, 1965b).

Still another approach to the study of personality determinants of conceptual behavior is reflected in the formulation of McGaughran and Moran (1954). In their model of intersecting axes, the quality of a concept in the repertoire of an individual is determined by its location in one of the four areas described by these axes, which were termed conceptual freedom and conceptual dimensionality. The two lower quadrants comprise the autistic conceptual area; the "public," "open-end" concepts (M-concepts) are located in the metastatic conceptual area; and "closed," "public" concepts (H-concepts) are located in the hypostatic conceptual area.

In testing this model, McGaughran and Moran devised an object sorting task. The "meaningful" objects to be placed in categories included toys, tools, implements of various kinds, etc. The concepts suggested in the arrangements of objects and subjects' explanatory verbalizations were located and evaluated in terms of the model.

The preceding pages have included brief discussion of a number of approaches to the problem of evaluating the relationships which may exist between personality variables and cognitive performance. The importance of such discussion in terms of the central problem toward which the present investigation was addressed lies in its consideration of the nature of potential influences on conceptual behavior.

Cognitive Features of Emotional Disturbance

In addition to questions of cognitive style, relating to patterns of individual differences in performance found in the general population, some questions have focused directly on the conceptual behavior of pathologically deviant groups. Assertions have been made concerning conceptual functioning of children who have been diagnosed as emotionally disturbed or emotionally handicapped. Many of these assertions have been made on the basis either of clinical observation and case history or of extrapolation from general theories of adult psychopathology.

According to many workers in the field of child psychopathology, however, neither the diagnostic classifications nor the treatment methods appropriate to adult pathology are appropriate to children (e.g., A. Freud, 1965). In addition, there would appear to be little consensus among workers concerning the etiology of personality disturbance or appropriate modes of treatment. Eysenck (1961, p. 2), for example, has noted "... knowledge of the 'causes' of psychiatric disorders is almost completely lacking and consequently diagnosis is based largely on symptoms and syndromes."

It was not within the scope of the present discussion, however, to examine diverse theoretical positions concerning the etiology and treatment of emotional disturbance. The intent of this discussion was to suggest variables reported to influence or be associated with the cognitive functioning of children who have been labeled emotionally disturbed.

Goldfarb (1961) has compared schizophrenic children to age-matched normal children on numerous dimensions, including several pertaining to conceptual functioning. He reported that the general conceptual functioning of schizophrenic children, including such processes as abstraction, categorization, speech, and other forms of communication, was decidedly inferior to those processes in normals. Specific observations included "... serious impairments in capacity to structure and pattern elementary perceptual stimuli" (p. 107). He surmised that conceptual deficits resulted from a "noncognitive ego weakness, "associated with the universal absence among schizophrenic subjects of "internal controls" and capacity to inhibit responses.

Vigotsky (1962) observed two chief modes of concept formation, conceptual and preconceptual, in a study of the categorization behavior of children and adult schizophrenics.

The schizophrenic subjects typically evinced the latter mode. The differentiation of conceptual and preconceptual parallels the dichotomy postulated by Goldstein and Scheerer (1941), which posited that schizophrenics, like organically impaired individuals, would be concretistic in their task behavior rather than use the abstract attitude.

Goldfarb (1961) observed two major classes of etiological factors in his generally impaired schizophrenic sample, one associated with the presence of organic pathology, the other with pathogenic features of the interpersonal histories of patients. With apparently differing etiology, however, the two groups of schizophrenic subjects exhibited the same general performance deficits and characteristics. Bender (1947; 1956), on the other hand, has asserted that although behavioral manifestations of schizophrenia may be diverse, an underlying commonality can be found in terms of pathogenic constitutional factors. Kessler (1966), Baer (1961), and others have discussed problems in the differential diagnosis of brain damage and schizophrenia.

Sylvia Farnham-Diggory (1966) used diverse indices in studying the concepts of self, future, and time among psychotic, brain-damaged, and normal children. She reported differential relationships between the two deviant groups and age and IQ trends in terms of these concepts.

Woodward's (1959) applications of Piagetian stage theory to research with severe mental defectives have included attempts to identify behavioral deviations. Those subjects whose problem solving behavior and use of circular reactions were incongruent in terms of sensorimotor stage of development were identified as evincing behavior problems as well. Her general conclusion was that Piaget's method provided a means of distinguishing normal and abnormal manneristic behavior among severely defective individuals. A related concern investigated by Woodward via Piagetian tasks is the problem of estimating the intellectual abilities of autistic children. Halpern (1966) reported Piagetian tasks more effective in isolating specific areas of developmental conceptual impairment in a schizophrenic boy than were the traditional intelligence measures.

The effects of institutionalization on the use of egocentric thought by emotionally disturbed children were investigated by Neale (1965). Disturbed children residing in an institution were significantly more egocentric than were disturbed children attending special classes in the community and living at home. That is, they were less able to identify views of a mountain scene other than that at which they themselves were looking. It seems possible that Neale's results might be interpreted in terms of severity of disturbance, rather than or as well as institutionalization per se.

Discussion has focused thus far on severe disturbances such as schizophrenia or the particular form of childhood psychosis identified as autism (Kanner, 1944). Emotional disturbance, however, is generally considered to cover a broad range of behavior patterns. The general aspect of behavior identified within this domain in the present discussion is that which relates directly to cognitive functioning, and in particular to the conceptual behavior of children. Few approaches to the analysis and study of emotional maladjustment have focused directly on the intellective or cognitive aspects, most tending to view behavior as controlled by external forces or libidinous drives. The idea of incorporating intellective and affecteive functioning within a comprehensive theory of human behavior is illustrated in the work of Rapaport (1951). In the view of Rapaport, such aspects of human functioning cannot be considered in isolation; ego processes and drives are interdependent and in continuous interaction.

Levine (1966) has noted that IQ changes over time have traditionally been associated with the influence of affective variables. Emotional disturbance is thought to interfere in some way with cognitive development in children and general cognitive functioning in adults as well. For example, Harris, (1961) has discussed extensively the learning-interference effects of "emotional blocks." Whether such is typically the case, that is, whether the onset of severe problems in the affective domain is typically highly correlated with a reduction in intellectual efficiency has been insufficiently explored, as Levine (1966) has noted.

Some studies (e.g., Spivack, Levine, and Sprigle, 1959) have found impulsiveness to be negatively correlated with intelligence test performance. Impulsiveness was seen as suggesting drive domination of or interference with cognitive functions, and was measured in terms of teacher ratings and task performance characteristics. Wolf (1965) found no significant differences between eighty children diagnosed as functionally emotionally disturbed and their sibling controls not so diagnosed in IQ or scholastic subject grades.

Davids and Oliver (1960) reported no significant differences between their "acting out" emotionally disturbed male subjects, receiving residential treatment, and a control group of normal children on an experimental task involving verbal learning of neutral words. When the stimulus words were emotionally charged (aggressive), however, the disturbed group made significantly more errors. The effects of neutral and socially meaningful stimulus words on the verbal conceptual performance of schizophrenic and brain damaged subjects were investigated by Bernstein (1961). Processes in the conceptual sorting behavior of the two groups, Bernstein found, were similar and were also similar to those evinced by normal controls. The differences appeared to relate to content, rather than process, the schizophrenics showing more impairment when social concepts were involved.

In a study in which schizophrenic and brain damaged adult patients participated in role-playing, Milgram (1961) concluded that the performances of the latter were inhibited by cognitive deficits, whereas schizophrenics seemed unable to empathize or to predict the behavior of another person. Weinstein (1965) studied social perceptual phenomena in a sample of emotionally disturbed boys. When asked to place human figures of a child, mother, and father on a flannel board, boys normally place the child closer to the father, but with disturbed boys this pattern was reversed. In addition, disturbed subjects placed human figures further apart than they placed abstract geometric figures. These findings were interpreted as suggesting that the disturbed subjects saw people more negatively than do normal boys of the same age.

In many discussions of the implications of emotional disturbance in children for education (e.g., Berkowitz and Rothman, 1960) an important role is accorded anxiety. This variable has been investigated at length within the framework of learning theory (e.g., Castaneda, Palermo, and McCandless, 1956) and of psychoanalytic theory (e.g., Sarason, et al., 1960) in terms of its effects on children's learning and general functioning in school.

Ferster and DeMyer (1961; 1962) have experimentally investigated the requisite conditions for expansion of the behavioral repertoire of autistic children. According to Ferster (1965) the behavior problems and patterns associated with the general diagnostic classification of autism are the result of differential reinforcement in the social histories of these children. Ullman and Krasner (1965) have described a general principle of behavior modification therapeutic approaches as a focus on increasing the freedom of the individual, that is, increasing his ability to make good choices through helping him to develop alternative responses.

Bower (1965; 1966) has referred to the behavior of emotionally maladjusted children as indicating the lack of "degrees of freedom," or "action alternatives." Thus, according to Bower, this child is impaired in the development of competency in interacting with his experiential world.

To Bower, (1966), competency involves both cognitive and emotional factors, and their interaction in a manner appropriate to the adaptive well-being of the individual is mediated by ego processes. Bower terms the relevant ego processes differentiation, fidelity, pacing, expansion, and integration. The presence of emotional disturbance in a child, as evidenced by some form of behavioral maladaptation, signifies defective ego functioning in terms of these processes.

Anna Freud (1965) considers ego development as paralleling libidinal development and directed toward ego mastery of the integrated personality. She has employed the concept of developmental lines to depict the normal patterns of growth in several areas of functioning, such as growth toward mature object relations.

Lippman (1962) has characterized the emotionally conflicted child as, in general, having a weak ego, particularly with regard to the synthesizing function of the ego. That is, ego control of an integrated, smoothly functioning personality has not been achieved in these children. Although various manifestations of conflict may be seen, such as agressive acting-out behavior, constriction and withdrawal, learning problems, and others, the basic factor, according to Lippman, is interference with ego functioning associated with anxiety.

Ego deficits have also been discussed by Bettelheim (1950) as characterizing the personalities of severely disturbed neurotic children. He noted the lack of personality integration, poor reality testing, and lack of ego control, as well as inhibition of learning, as indicators of a poorly operating ego.

According to Pearson (1954) learning, and in particular school learning, is an ego function. In his psychoanalytic view, learning is directed toward the supremacy of secondary processes over primary processes.

In instances of emotionally disturbed thinking, from the psychoanalytic orientation, primary processes emerge from the subconscious and interfere with ego control of thought and behavior. Evidence of such interference and the internal conflict with which it is associated is obtained through the clinical use of tests such as the Wechsler Intelligence Scale for Children (WISC) (Schafer, 1948). Wechsler (1958) has suggested certain constellations of scores on the WISC and WAIS which have frequently been found to be associated with schizophrenia and other disorders.

An important consideration in the present discussion pertains to the characteristics of emotionally disturbed children who are enrolled in special public school classrooms. According to Morse, Cutler, and Fink (1964), more than half of the disturbed pupils in special classes visited in their study were considered to fall within the neurotic classification of disturbance. The acting-out neurotic boys comprised the largest single group, with a very small percentage of the special class enrollment being composed of organically impaired or schizophrenic children.

A majority of the children in special classes analyzed by Morse, Cutler, and Fink showed academic retardation, but since a normal or slightly higher than normal IQ distribution was found, academic retardation was attributed to emotional factors. In their words, "... it seems safe to say that whatever academic retardation did exist, it was based upon other than intellectual factors." (1964, p. 35).

Summary

Approaches to the study of emotional disturbance in children appear to have focused either on the internal aspects of emotional conflicts or the direct expression of these conflicts in maladaptive behavior, such as aggressive acting-out behavior or extreme withdrawal. Only in the case of schizophrenic conditions have cognitive functioning features of the disturbance been emphasized.

In the preceding discussion, however, a number of possible characteristics of cognitive functioning in disturbed children have been mentioned. In addition, the general topic of the interaction of cognitive and personality variables suggested some possible characteristics associated with modes of conceptual behavior.

A recurring theme in the discussion of cognitive aspects of emotional disturbance was that of emotional interference with cognitive functioning, associated with deficiencies in ego control. Thus, conceptual behavior would be characterized by the intrusion of "primary process material," or instinctual conflict relating to unresolved problems of earlier development.

Possible conceptual behavior characteristics associated with disturbance when viewed in such a way might include:

impulsivity; animistic thinking; inconsistent or erratic performance; egocentric, idiosyncratic, or bizarre conceptualization; field dependence; and differential effectiveness depending on the task content; that is, better performance on neutral than on social or "affect-charged" tasks.

In some conceptions of the characteristics associated with emotional disturbance in children, performance characteristics similar to those described above are attributed to the previous learning histories of individuals, rather than to internal conflict. The theoretical approaches appear to concur, however, in the identification of the behavioral characteristics themselves; the differences between approaches relate to views of etiology, explanations of the significance of current behavior, and preferred mode of treatment.

Although many research findings have indicated that intellective functioning is often impaired by emotional maladjustment, there would seem to be some consensus in the view that such impairment is based on factors other than those usually associated with the impairment characterizing mentally retarded children. An implicit assumption is that, even in instances of disturbed children who nevertheless maintain academic achievement, affective interference (or previous learning of maladaptive behavior) impedes or impairs cognitive functioning, at least in some areas.

The predictions of the present study, to be stated subsequently in operational terms, were that performances of children in special classes for the emotionally disturbed would be more like the performances of normals in certain respects than like those of mentally retarded children. Although expected to exhibit patterns of cognitive functioning reflecting similarities to normal children of the same age in quantitative respects, however, some assumptions were made on the basis of the literature suggesting that differences between disturbed and normal children would be of a qualitative nature.

In terms of the cognitive matrix theory, the disturbed child was predicted to have as many concepts at his disposal as his normal peer. However, the nature of these concepts and of the conceptual dimensions, i.e., the associations between concepts in the matrix, was expected to lack the utility for effectiveness in performance on a task of concept formation, recognition, and utilization.

V. METHODOLOGY

The intent of the present study was to explore several aspects of the cognitive functioning of children who have been classified, for educational purposes, as emotionally disturbed, mentally retarded, and normal. The specific variables under consideration were dimensions yielded in the scoring of Dunn's Object Sorting Task (OST).

The OST was developed in order to test hypotheses generated by a theory of cognitive structure, which depicts structural and process features of concept attainment, storage, and utilization. The theory is capable of generating research questions regarding variance in cognitive performances. However, predictions regarding the functioning of certain groups of subjects must rely to some extent on the body of literature describing the characteristics of those groups.

The variables in question, derived from both language and motor behavior, were related to level of conceptual attainment, nature of cognitive organization, fluency of conceptualization, ease of information retrieval, and cognitive flexibility.

The sample in the study was composed of three subgroups which were compared with regard to the above characteristics. Of interest were areas both of similarity and difference between groups. Intergroup differences predicted in the study were of two general types: quantitative and qualitative. The general hypotheses discussed in earlier chapters were:

1) Emotionally disturbed children do not differ from normal children in size of the cognitive matrix, when age and IQ are controlled.

2) Differences between emotionally disturbed and normal children reflect differences in the nature of the relationships comprising the matrix, i.e., qualitative differences.

3) Mentally retarded children differ from normal children, when age is controlled, in size of the cognitive matrix.

4) Mentally retarded children do not differ from normal children of the same age in the nature of the organization of the cognitive matrix.

Subjects

The Emotionally Disturbed Group

One of the groups of subjects in the present study comprised members of public school classes for the emotionally handicapped, in this instance termed Adjusted Study Program (ASP) classes by the school systems in which the classes were located. Although psychiatric and psychological evaluation of candidates is a requisite for such placement in the state in which this study was carried out, neither the term "emotionally disturbed" nor the term "emotionally handicapped" specifies particular diagnostic categories of psychopathology or behavioral syndromes.

According to teachers and officials in the school systems, the majority of referrals for consideration for ASP placement have emanated from classroom teachers. Actual placement in the ASP program requires parental approval and the recommendation of school special services personnel and a psychiatrist. The latter is typically in private practice or practices in a child guidance clinic. Psychiatric recommendation for ASP placement is normally sought by the parents or by school officials in cooperation with the parents.

A sample of forty male pupils, drawn from seven ASP classes representing as many elementary school buildings and discrete local school districts, was selected. The large county school system in which these districts are located comprises twenty-nine autonomous local school districts in suburban areas, adjoining a large metropolitan urban area. Thirteen of these districts offer elementary school-level

ASP programs, involving classes at one or more of three educational levels: lower elementary, upper elementary, and junior high. The sample in the present study was drawn from upper elementary-level classes.

Children suffering temporarily from situational stress reactions, as well as chronically from severe disorders, are ineligible for placement in the program. Severely physically handicapped, multiply handicapped, brain-injured, and mentally retarded children are likewise ineligible. According to administrative policy, candidates must have an IQ of 90 or higher. Those admitted to the program must have a relatively good prognosis for quick return--within about two years--to a normal classroom placement. Programs had not been in existence in several of the districts long enough to determine whether rehabilitation had in fact progressed this rapidly.

In several cases, ASP class programs are overseen by a coordinator of special services of the local school district. In all cases, a contact person, in addition to the teacher and building principal, is associated with the program. Consultation for all ASP class programs throughout the county system is furnished by a consulting supervisor, who participates in the coordination of programs among the various districts, and who is responsible to the director of special education of the county system.

In the ASP classes from which the present sample was drawn, class size ranged from five to ten pupils, class populations were predominantly male. Classroom atmosphere, teaching style, curriculum, management procedures, and so forth, were individually determined. In all cases, however, the goal of special class placement was return to the regular classroom. In a number of cases, evidences of gradual reintegration into normal programs of individual pupils was in evidence.

ASP subjects in the present study were generally residents of the school districts in which the special class was located. These districts served relatively similar communities in terms of socioeconomic level and sociocultural composition, according to county school system officials. Since ASP subjects were drawn from seven of the twenty-nine districts in the system and represented one-half of those districts offering special programs, the variance in socioeconomic level in the county system was thought to be adequately reflected by the sample. None of the ASP subjects in the study was an adjudged delinquent or ward of the court, and in nearly all cases both parents were present in the home.

The ASP subjects ranged in age from nine years of age to twelve years, none months. Tables 1 and 2 summarize the

TABLE 1

AGE, IQ, AND ACHIEVEMENT CHARACTERISTICS OF NORMAL, MENTALLY RETARDED, AND EMOTIONALLY DISTURBED GROUPS

Variable	Group I (Normal)			Group II (Retarded)			Group III (Disturbed)		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Age	40	10.5	.83	40	11.4	.93	40	11.2	.99
IQ	38	103.0	10.81	40	71.8	14.17	37	98.5	11.70
Achieve: Reading	37	4.8	1.65	31	2.7	1.06	34	4.6	1.64
Arith.	37	4.8	1.16	31	3.0	.89	33	4.7	1.25
Total	37	4.8	1.35	31	2.9	.91	33	4.6	1.32

age, IQ, and academic achievement characteristics of the group in comparison to the retarded and normal groups.

For seventeen of the ASP subjects, nearly one-half of the sample, the present year was their first of special class placement. Thirteen had been so placed for one year prior to the present year, and ten for two or more years.

Nine of the forty ASP subjects were known by their teachers to be receiving some form of medication, i.e., drug treatment, and several were receiving some form of individual or family psychotherapy.

TABLE 2

COMPARISON OF AGE, IQ, AND ACHIEVEMENT GROUP MEANS OF NORMAL, RETARDED, AND DISTURBED GROUPS

Variable	Group Mean Comparison	t
Age	Groups I & II	4.71***
	Groups I & III	3.29***
	Groups II & III	1.20 NS
IQ	Groups I & II	10.89***
	Groups I & III	1.75*
	Groups II & III	8.96***
Achievement:		
Reading	Groups I & II	6.03***
	Groups I & III	.28 NS
	Groups II & III	5.66***
Arithmetic	Groups I & II	6.97***
	Groups I & III	.42 NS
	Groups II & III	6.08***
Total	Groups I & II	7.00***
	Groups I & III	.68 NS
	Groups II & III	6.22***

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$
NS = not significant

Group I = Normal
Group II = Retarded
Group III = Disturbed

The Mentally Retarded Group

Subjects comprising this group were members of special classes in the same county school district and, in many cases, in the same schools as those from which the emotionally disturbed sample was drawn. These classes were part of Type A programs for the educable mentally retarded within the local school districts, which conform to the requirements set forth for Type A special class programs by the Michigan State Department of Education.

In order to be admitted to the Type A program, children must be "potentially socially competent." Although some deviation is reflected in the present sample, the IQ range in Type A programs is from 50 to 75, and must be based upon the individual administration of the Stanford-Binet Intelligence Scale or the Wechsler Intelligence Scale for Children (WISC), or other suitable measure. Screening for special classes, in Michigan, is largely on the basis of individual testing by a school diagnostician, a psychological examiner with approximately two years of graduate training.

A sample of forty male pupils was drawn from a total of nine Type A classes. These classes were located in six buildings, each in a different local school district, within the county school system. All of the twenty-nine local school districts in the county system offer elementary-level classes for the mentally handicapped; thus, all subjects in the present sample were known to reside in the district in which they attended school.

Coordination of these classes, and consultation with teachers, is the responsibility of a consulting supervisor attached to the administrative office of the county system. In the case of several of the local districts, a coordinator of special services or special consultant is responsible for all special programs for the mentally handicapped within that particular district.

Pupils in Type A programs, in contrast to ASP pupils, were generally expected to remain in special class placement throughout their school career. Consequently, instructional goals, methods, and materials differed from those found in ASP classes. In addition, class size, though still smaller than that of normal classes, was generally somewhat larger and in some cases much larger than ASP class size. As in the ASP classes, teaching styles and management techniques appeared to be individually determined.

The sample drawn from Type A classes for the mentally handicapped in the county system was assumed to be comparable to the ASP sample in terms of socioeconomic class status and sociocultural composition. A summary of the age, IQ, and academic achievement characteristics of the retarded sample, in comparison to the emotionally disturbed and normal groups, is provided in Tables 1 and 2.

The Normal Group

The normal subjects in the present study were fourth, fifth, and sixth grade male pupils who attended school in a district adjoining the county system from which the other groups were selected. All of the forty normal subjects were in regular classroom placements in a large elementary school. Fourteen male pupils in each of grades 4, 5, and 6 were randomly selected, and since these subjects tended to be younger than those in either special group, the two youngest normal subjects were dropped from the study.

Since the district from which the normal subjects were selected was located in the same area as were the emotionally disturbed and mentally retarded subjects' school districts, and represented ecological features which were generally very comparable to those districts, some degree of socioeconomic control was obtained. The normal subjects' school district was regarded by school personnel and other observers to be fairly homogeneous in terms of socioeconomic class composition and pupils' home background.

The age, IQ, and academic achievement characteristics of the normal sample are summarized in Table 1. This group was very comparable to the emotionally disturbed group in IQ, but significantly different ($p<.001$) from the mentally retarded group, as Table 2 shows. Normal subjects ranked higher than subjects in either special group in academic achievement, although they were slightly younger than the subjects in either of the two special groups.

Methods of Data Collection

Instruments

The major source of data in the study was Dunn's Object Sorting Task (OST), a measure designed to yield scores on manipulative sorting and language behavior reflecting concept formation and concept recognition.

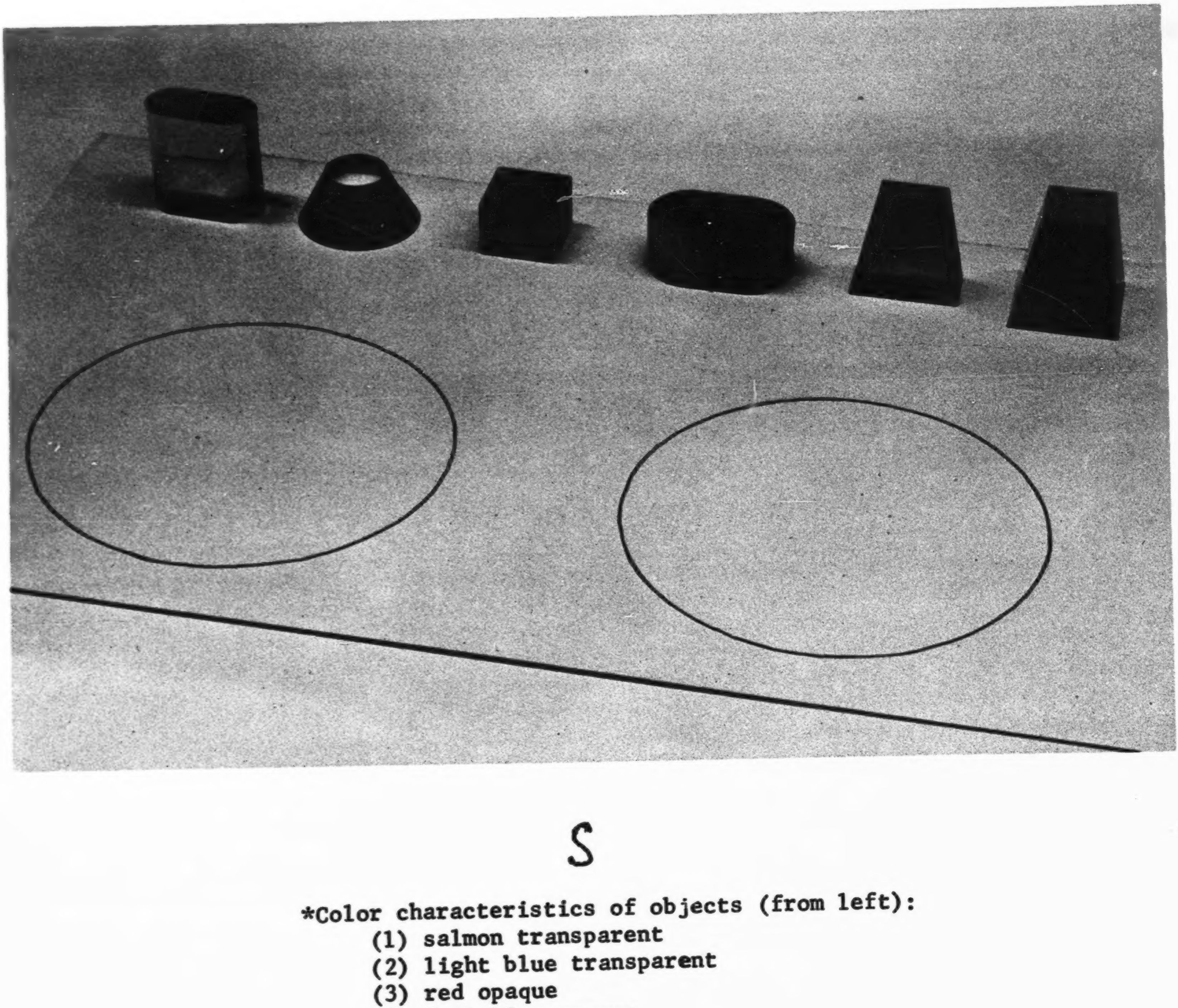
In the OST, the subject is asked to sort six plastic objects, differing from each other on various dimensions, into equal dichotomous groups in as many different ways as possible. He is then asked to explain his basis for sorting. The objects, abstract geometric shapes of differing color characteristics, are shown in Figure 1.

There are ten possible ways of grouping the objects into sets of three, and nine possible ways of arranging them into two groups with each group representing a pole of a conceptual dimension.

FIGURE 1

THE OBJECT SORTING TASK (OST) STIMULUS OBJECTS*
SHOWN IN THE NONDIMENSIONAL STARTING POSITION

E



S

*Color characteristics of objects (from left):
(1) salmon transparent
(2) light blue transparent
(3) red opaque
(4) dark blue opaque
(5) dark blue transparent
(6) pink opaque

The nine possible correct sorts, in empirically determined order of difficulty are: (1) Angularity; (2) Hue; (3) Transparency; (4) Height; (5) Perpendicularity of sides; (6) Equality of the radial axes of the base; (7) Color intensity; (8) Volume; and (9) Area of the base. The tenth, nondimensional, arrangement is used for the starting position; after each attempt, the objects are returned to this position.

The arrangement of materials as the task is begun is shown in Figure 1. The examiner records the subject's sorts, together with descriptions of his apparent approach to the task and manner of sorting, and the subjects' verbal explanations during the administration of the task. Sessions in the present study were tape recorded and the recordings later used to verify protocols. Other physical materials, in addition to the objects themselves and recording equipment, included a stop watch, desk or work table and chair, and a white cardboard administration mat on which all task activities were carried out. The objects were placed equal distances apart, in a straight line reflecting the incorrect "blank" arrangement, and the subject was instructed to sort the blocks into two circumscribed areas drawn on the administration mat.

To establish the proper set, a demonstration sorting task, using pencils, was employed prior to the blocks. This allowed the examiner to ascertain that the subject understood what he was to do.

The OST comprises two phases, termed the Divergent and Convergent procedures. In the Divergent procedure, the subject is instructed to sort the objects in as many ways as possible. After each sort, he is asked why he sorted them in that way. When the subject can produce no more sorts, exceeds 120 seconds in producing a sort, or exceeds the limit of allowable duplicate sorts (nine in this study, or five replications of the same arrangement), the Divergent testing phase is terminated.

He is then shown, in order of difficulty, those possible correct sorts he failed to use. After each grouping, the subject is asked why the objects could be sorted in that particular way. This Convergent testing, or concept recognition, phase is terminated when three trials are missed.

Deriving from the prescribed scoring procedures are several scores dealing with: concept identification speed, number of positive (correct) sorts, number of erroneous sorts, number of duplicate sorts, sorting style, level of concept attainment, quality of verbalization, etc. Detailed administration procedures and the OST verbalization scoring manual may be found in Appendices A and B, respectively. Appendix C describes the specific OST variables under consideration.

Other pupil data were obtained from the cumulative school records. For the normal group, the language, non-language, and total IQ scores were obtained from records of school-administered California Test of Mental Maturity (CTMM) examinations. Academic achievement indices for this group were Iowa Test of Basic Skills subtest grade placement scores on reading and arithmetic, and total battery scores.

IQ and achievement measures for the ASP and Type A subjects were diverse. However, Verbal Scale, Performance Scale, and Full Scale IQ scores from the Wechsler Intelligence Scale for Children (WISC) were obtained for approximately seventy-five percent of the emotionally disturbed and approximately eighty percent of the retarded sample. Other IQ scores for these subjects, in all but one or two instances, were based on the Stanford-Binet Intelligence Scale. The most frequent achievement measure for these groups was the Wide Range Achievement Test (WRAT). Other achievement measures were the Metropolitan, the Iowa, the SRA, and the California

(CATB) batteries. For each disturbed or retarded subject, a score for reading (total) and arithmetic (total) was obtained. If no total battery scores was given (as in the case of the Wide Range), the mean of these two scores was used as the total achievement measure. It was recognized that this diversity of measures precluded trustworthy comparative academic achievement statements about the three groups. Achievement and IQ data were collected primarily for descriptive and identification purposes.

Additional descriptive information about the subjects in the special groups was obtained in the form of Pupil Behavior Inventory (PBI) ratings made by each teacher. Five factor scores were obtained: (1) Classroom conduct; (2) Academic motivation and performance; (3) Socio-emotional state; (4) Teacher dependence; (5) Personal behavior. These data for the two special groups are summarized in Table 3.

Procedures

After testing approval was secured from special services administrative and consultative personnel of the county school system, building principals, other involved administrators, and the classroom teachers in the

TABLE 3

MEANS AND STANDARD DEVIATIONS OF THE PUPIL BEHAVIOR INVENTORY (PBI) FACTOR SCORES FOR THE RETARDED AND DISTURBED GROUPS

PBI Dimension	Group II (Retarded)			Group III (Disturbed)		
	N	Mean	SD	N	Mean	SD
I. Classroom Conduct	38	3.31	.88	35	2.29	.77
II. Academic Motivation and Performance	40	3.14	.94	35	2.87	.69
III. Socioemotional State	40	4.12	.51	35	3.35	.81
IV. Teacher Dependence	33	3.22	.94	35	2.40	.82
V. Personal Behavior	33	4.38	.79	35	3.98	.67

respective schools, all subjects were individually administered the Object Sorting Task. Testing of A$P and Type A subjects was carried out between October and December, 1966. Subjects in regular class placements (the normal group) were tested between December, 1966, and March, 1967.

Other pupil data, from school cumulative record folders, was supplied by building principals and/or classroom teachers and was collected between February and April, 1967. During this same period, teachers of pupils in both types of special class placement were sent the Pupil Behavior Inventory (PBI) forms by mail and asked to complete them.

Administration of the OST was carried out in rooms assigned by the principal or secretary in the respective buildings. These rooms were usually vacant classrooms, music rooms, special services rooms, or offices. Subjects came, or were escorted by the examiner, individually to the testing rooms. Testing required from fifteen to thirty minutes, depending upon individual variations in productivity, response latencies, and ease in comprehension of the instructions. The examiner attempted to adhere to a standard, task-centered, businesslike, but warm and friendly, mode of interaction with the subjects.

Variations in procedure were permitted in the administration of the demonstration sorting problem, (see Appendix A). After introducing the task verbally the usual mode was to arrange the six pencils into two groups, three being new, unsharpened pencils, and three having points. The subject was then asked the basis for this sort. This was repeated for the second possible arrangement: three pencils had erasers and three had "nothing on the end." The subject was then asked to form a third arrangement (three of the pencils had pocket clips and three were "plain") and to explain his basis for sorting. Teaching techniques, including repetition, were sometimes used if deemed necessary. The goal of the demonstration activity was to ascertain that the subject understood that he was to: (1) have three things in each group, (2) always put "three things here and three things here" (in respective areas indicated by circles),(3) always be sure that "everything in this group is alike in some way," and (4) realize there may be more than just one way to sort six items. If a subject proceeded to carry out the entire demonstration or a part of it spontaneously, he was permitted to. If he did so erroneously, the correct procedure was demonstrated and the rules re-emphasized and repeated.

Subjects were not criticized for erring in the demonstration. During the task itself, the examiner attempted to convey neither positive nor negative feedback to the subject; the attempt was made to standardize all forms of interaction. All question, such as: "Can I do it this way?"

"Do they have to be the same?" "Did I already do it this way?" "Is that right?" were responded to with a standardized general reference to the instructions: "Remember the instructions."

While, some subjects occasionally inquired about the tape recorder, microphones, or stop watch, few were overtly concerned. The few subjects that did manifest some measure of distraction by the equipment were handled in a non-threatening and non-punitive manner, so that the examiner could be relatively certain that the subject was focusing on the task and was not negatively disposed to the activity. Every attempt was made to put subjects at ease, but irrelevant discussions were avoided.

Teachers were asked to provide general preparations by explaining that the examiner was engaged in a research project and seeing a great many children of different ages and in various grades and schools. A few minutes of their time was required to perform an activity, but the activity was not a test and had nothing to do with their school work. In all cases but one, subjects were quite willing and quite often eager to participate. The single exception who expressed some reticence was an ASP subject who had to be individually assured that the task was not an IQ test and would not affect his "record." There were no instances of acting out, withdrawal or other forms of resistance, hesitancy, or poor behavior control.

Operational Hypotheses

In terms of expected sorting and verbalization performance on the OST, the two general difference hypotheses of Chapter II may be stated operationally as:

General Hypothesis 1

> Performance of emotionally disturbed children on the experimental task will differ qualitatively from that of normal children.

Operational Hypotheses:

a) Emotionally disturbed subjects will perform more erroneous sorts.

b) Emotionally disturbed subjects will perform more duplicate sorts.

c) Order of emergence of sorts will be unrelated to order of difficulty for emotionally disturbed subjects.

d) The emotionally disturbed group will have greater intragroup variability on all task dimensions.

e) Speed of sorting will remain relatively constant throughout the task for emotionally disturbed subjects.

f) Emotionally disturbed subjects will perform more "sign" sorts and "primitive functional" sorts.

General Hypothesis 2

Performance of mentally retarded children on the experimental task will differ quantitatively from that of normal children.

Operational Hypotheses:

a) Mentally retarded subjects will perform fewer positive sorts.

b) Mentally retarded subjects will have lower mean verbalization scores.

c) First sort reaction time will be longer for mentally retarded subjects.

d) The total number of sorts performed by mentally retarded subjects will be less.

e) Although mentally retarded subjects will perform fewer positive sorts, the order of emergence of these sorts will be related to the order of their difficulty.

Methods of Data Analysis

Analysis of variance was the major statistical technique used in testing the specific hypotheses indicated above. Inasmuch as the data bank was amenable to further inquiry, several exploratory analyses were undertaken in addition to the basic theory testing activities.

Sizeable correlations of OST variables with age, IQ, and academic achievement scores were not expected because of the homogeneity expected to characterize the special class groups with respect to the latter dimensions. Nevertheless, correlation matrices were obtained for each group and selected multiple and partial correlations were analyzed.

A cluster program for multiple discriminative analysis of data, developed by Professor M. Clemens Johnson of the University of Michigan School of Education, was also performed in order to identify subjects whose performances on the important variables were clustered. It was hoped that the groups obtained through such a procedure might suggest potential instructional groupings in terms of cognitive characteristics.

The multiple and partial correlational analyses were based on nomographs prepared by Lord (1955) and Lees and Lord (1961). All other analyses were performed through the facilities of the University of Michigan Computing Center, with the guidance of Professor Johnson.

VI. RESULTS

The results obtained in the present study can be discussed in terms of the several specific hypotheses listed in Chapter V and also in terms of new hypotheses generated by the data. The latter are suggested near the conclusion of the present chapter and discussed in more detail in Chapter VII.

The hypotheses of Chapter V predicted similarities and differences between mentally retarded and normal children and between emotionally disturbed and normal children. The primary statistical presentations treat these particular similarities and differences. In the interest of heuristics, however, comparisons between the retarded and disturbed groups were also made.

The performances of the subjects in the three subgroups, on all OST scoring dimensions, were subjected to analysis of variance. Ten of the eighteen scoring dimensions for which such analysis was feasible produced significant group differences (eight at the .01 level, two at the .05 level). Several of these measures are not mutually

TABLE 4

SUMMARY OF PREDICTED AND OBTAINED GROUP DIFFERENCES SUGGESTED BY ANALYSIS OF VARIANCE

OST Variable	Level of Significance	Direction High----Low
No. Correct Sorts (Div.)	.01	N ≥ D ≥ R
No. Correct Sorts (Div. + Conv.)	.01	N ≥ D ≥ R
Mean Verbal. Score (Div.)	.01	N ≥ D ≥ R
No. Verbal. Categories	.01	N ≥ D ≥ R
Proportion Correct Sorts	.01	N ≥ D,R
No. Correct Sorts (Conv.)	.05	N ≥ D,R
Mean Verbal. Score (Conv.)	.01	N ≥ D,R
No. Blank Sorts	.05	N ≥ D,R
No. False Positive Sorts	NS	
No. Duplicate Sorts	NS	
Total No. Sorts (Div.)	NS	
Speed First Sort	NS	
Mean Speed of Sorting	NS	

N = Normal group
D = Disturbed group
R = Retarded group

(≥) = Significant group difference
(,) = Nonsignificant group difference

independent, however. Table 4 summarizes the results of analysis of variance in terms of group differences which were obtained and those which were hypothesized but were not significant. In order of magnitude of effect, the OST dimensions yielding significant group differences were:

1) Total number of verbalized positive sorts performed during the Divergent phase.
2) Total number of dimensional categories employed in verbal explanations of sorting.
3) Total number of adequate positive sorts (verbalized and nonverbal) performed during the Divergent phase.
4) Mean verbalization score on the Divergent phase.
5) Total number of Divergent and Convergent positive sorts.
6) Proportion of adequate positive sorts to total number of sorts performed during the Divergent phase.
7) Proportion of verbalized positive sorts to total number of sorts performed during the Divergent phase.
8) Mean verbalization score on the Convergent phase.
9) Total number of positive sorts, i.e., correctly identified sorts, on the Convergent phase.
10) Total number of blank (nondimensional) sorts performed during the Divergent phase.

All of the above OST dimensions which produced significant results bear directly or indirectly on the hypotheses tested in the study. Several hypothesized relationships, however, were predicted in terms of OST performance indices not included above. Three of these indices were amenable to methods of analysis other than analysis of variance and are discussed subsequently. Some indices, however, which were predicted to differentiate performances of the groups were found via analysis of variance to produce no significant group differences. These were speed (number of seconds required) on the first sort, number of duplicate sorts, and number of false positive sorts, all during the Divergent testing phase. Two additional sorting patterns, usually occurring as forms of false positive sorts, were very infrequently performed by subjects in any of the three groups. These were "sign" sorts and "primitive functional" sorts.

Table 5 summarizes the results of analysis of variance in the three sample groups for number of dimensional categories employed in verbal explanations of sorting behavior. The significant effect produced by this variable ($F = 13.88$, $p \leq .001$) indicated that the groups were differentiated in terms of the number of dimensions used in verbalizations, irrespective of the appropriateness of usage of these dimensions. Eighteen percent of the variance in performance within the sample on this variable could be accounted for by knowledge of the group membership of subjects.

The group means and standard deviations of the normal, retarded, and disturbed groups are reported in Table 6. Both normal and disturbed subjects employed significantly more dimensions in explaining the basis for sorting than did retarded subjects ($t = 5.12$ and 3.58, respectively), and both differences were significant at the .001 level. However, normal subjects exceeded disturbed subjects on this variable as well, albeit at a lower level of significance ($t = 1.69$, $p \leq .05$).

Adequacy of performance on the task can be measured in terms of the total number of correct sorting arrangements executed by a subject on the Divergent testing phase. Since nine correct dimensional arrangements are possible, a subject's maximum score would be nine. Occasionally an individual may be able to sort the blocks accurately without being able to verbally express the basis for sorting, even though the examiner may be convinced a dimensional concept has been utilized. Such a sort is regarded as a

TABLE 5

ANALYSIS OF VARIANCE OF NUMBER OF CATEGORIES USED IN VERBALIZATIONS IN THE DIVERGENT PHASE FOR NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	48.72	2	24.36	13.88**
Within groups	200.05	114	1.75	
Totals	248.77	116	est.	ω^2 = .18

**p ≤ .01

TABLE 6

GROUP MEANS AND STANDARD DEVIATIONS FOR NUMBER OF CATEGORIES USED IN DIVERGENT PHASE VERBALIZATIONS

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	39	3.46	1.43	Groups I & II	5.12***
II (Retarded)	38	1.89	1.13	Groups I & III	1.69*
III (Disturbed)	40	2.92	1.38	Groups II & III	3.58***

*p ≤ .05
***p ≤ .001

nonverbal positive sort. Thus, correct (positive) sorts performed during the Divergent phase may be of two types: verbalized and nonverbal.

When group performances in terms of total number of verbalized positive sorts were subjected to the analysis of variance, a significant difference was found ($F = 13.74$, $p \leq .01$). This effect, however, was only slightly greater than that obtained when both verbalized and nonverbal positive sorts were combined in scoring. These results are summarized in Tables 7 and 9, respectively. The only group which appeared to be affected by selecting one of these variables, number of verbalized sorts or number of verbalized and nonverbal sorts, was the retarded group. When both types were considered, the difference between normal and retarded group means was reduced from a t-ratio of 5.38 to one of 4.68, as shown in Tables 8 and 10. In both cases, however, the difference was significant at the .001 level. The level of significance of the difference between retarded and disturbed group means was reduced from .01 to .05 when number of verbal and nonverbal sorts was the OST variable under consideration.

A subject's mean verbalization score on the Divergent phase of the task reflects the average quality of his

TABLE 7

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF VERBALIZED AND NONVERBAL POSITIVE SORTS PERFORMED BY THE NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	43.31	2	21.66	11.65**
Within groups	208.25	112	1.86	
Totals	251.57	114	est. ω^2 = .16	

$^{**}p \leq .01$

TABLE 8

GROUP MEANS AND STANDARD DEVIATIONS FOR TOTAL NUMBER OF VERBALIZED AND NONVERBAL POSITIVE SORTS

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	39	3.56	1.45	Groups I & II	4.90***
II (Retarded)	36	2.06	1.19	Groups I & III	2.75**
III (Disturbed)	40	2.67	1.42	Groups II & III	2.04*

$^{*}p \leq .05$
$^{**}p \leq .01$
$^{***}p \leq .001$

TABLE 9

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF POSITIVE SORTS PERFORMED BY NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	49.20	2	24.60	13.74**
Within groups	198.66	111	1.79	
Totals	247.86	113	est. ω^2 = .18	

**$p \leq .01$

TABLE 10

GROUP MEANS AND STANDARD DEVIATIONS FOR TOTAL NUMBER OF POSITIVE SORTS

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	39	3.51	1.43	Groups I & II	5.38***
II (Retarded)	35	1.89	1.13	Groups I & III	2.78*
III (Disturbed)	40	2.63	1.41	Groups II & III	2.48**

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

verbal explanations of the basis for sorting, irrespective of the number of correct sorts performed. As Table 11 shows, a significant effect ($F = 11.13$, $p \leq .01$) in differentiating group performances was produced by this variable. Fifteen percent of the variance in mean verbalization was accounted for on the basis of group membership. The retarded and disturbed groups did not differ significantly on their average ability to provide adequate verbal rationalizations for sorting behavior. Both groups, however, were very significantly inferior to the normal group in terms of this dimension ($p \leq .001$). The group means and standard deviations for mean verbalization scores on the Divergent phase are presented in Table 12.

When the total number of positive sorts performed during the Divergent phase was combined with the total number of correctly identified arrangements in the Convergent phase, the resulting OST variable produced a significant effect ($p \leq .01$) in suggesting the presence of group differences. The results of analysis of variance are summarized in Table 13. Although both retarded and disturbed performances were inferior to that of normals, the difference between the retarded and normal groups was considerably greater.

TABLE 11

ANALYSIS OF VARIANCE OF DIVERGENT PHASE MEAN VERBALIZATION SCORES OF NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	328.93	2	164.47	11.13**
Within groups	1639.97	111	14.77	
Totals	1968.90	113	est. ω^2 = .15	

**p ≤ .01

TABLE 12

GROUP MEANS AND STANDARD DEVIATIONS FOR DIVERGENT MEAN VERBALIZATION SCORES

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	39	4.76	.76	Groups I & II	4.68***
II (Retarded)	35	3.53	1.44	Groups I & III	4.10***
III (Disturbed	40	3.74	1.36	Groups II & III	.66

***p ≤ .001

($t = 4.96$, $p \leq .001$) than that between the disturbed and normal groups ($t = 2.30$, $p \leq .05$). The disturbed group mean was located approximately midway between the other group means on total number of positive Divergent and Convergent sorts. These intergroup comparisons are shown in Table 14.

Group differences were found in terms of the ratio of correct Divergent sorts to the total number of sorts performed during this phase, that is, the proportion of positive sorts. When verbalized and nonverbal positive sorts were combined as the dependent variable, a greater effect was produced than when only verbalized positive sorts were considered ($F = 9.54$ and 8.48, respectively), although both effects reached the .01 level of significance. The results of these analyses are summarized in Tables 15 and 17, respectively. In both instances, normal subjects performed a significantly larger proportion of positive sorts ($p \leq .001$). Retarded and disturbed groups means did not differ significantly in either case.

It might appear possible that subjects who perform well on the Divergent phase, as did the normal group in the present investigation, relative to the two special groups, would be unlikely to obtain high scores on the

TABLE 13

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF DIVERGENT AND CONVERGENT CORRECT SORTS PERFORMED BY NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	57.63	2	28.81	11.02**
Within groups	300.81	115	2.62	
Totals	358.44	117	est. ω^2 = .15	

**p ≤ .01

TABLE 14

GROUP MEANS AND STANDARD DEVIATIONS FOR TOTAL NUMBER OF DIVERGENT AND CONVERGENT SORTS

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	39	4.54	1.74	Groups I & II	4.96***
II (Retarded)	39	2.82	1.27	Groups I & III	2.30*
III (Disturbed)	40	3.63	1.78	Groups II & III	2.31*

*p ≤ .05
***p ≤ .001

TABLE 15

ANALYSIS OF VARIANCE OF PROPORTION OF POSITIVE VERBALIZED AND NONVERBAL SORTS PERFORMED BY NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	1643.33	2	821.67	9.54**
Within groups	9647.05	112	86.13	
Totals	11290.38	114	est. ω^2 = .13	

**p ≤ .01

TABLE 16

GROUP MEANS AND STANDARD DEVIATIONS FOR PROPORTION OF VERBALIZED AND NONVERBAL POSITIVE SORTS

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	39	.714	.284	Groups I & II	3.98***
II (Retarded)	36	.435	.321	Groups I & III	3.48***
III (Disturbed)	40	.494	.276	Groups II & III	.86 NS

***p ≤ .001

TABLE 17

ANALYSIS OF VARIANCE OF PROPORTION OF POSITIVE VERBAL SORTS PERFORMED BY NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	1453.99	2	727.00	8.48**
Within groups	9516.64	111	85.74	
Totals	10970.63	113	est. ω^2 = .12	

**p ≤ .01

TABLE 18

GROUP MEANS AND STANDARD DEVIATIONS FOR PROPORTION OF POSITIVE VERBAL SORTS

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	39	.710	.289	Groups I & II	3.62***
II (Retarded)	35	.457	.312	Groups I & III	3.48***
III (Disturbed)	40	.488	.279	Groups II & III	.45 NS

***p ≤ .001

Convergent phase. That is, a subject who performs all easier sorts correctly on the first phase would be given only the more difficult sorts on the second. However, in this sample, both the dimensions of number of correctly identified Convergent sorts and mean verbalization score on the Convergent phase produced significant group differences, clearly in favor of the normal group. Results of analysis of variance and specific intergroup mean comparisons are presented in Tables 19 and 20, respectively, for number correct on the Convergent phase. These results for mean Convergent verbalization scores are presented in Tables 21 and 22. The largest intergroup difference was that between normals and retardates on mean verbalization ($t = 3.97$, $p \leq .001$). Although disturbed subjects appeared to exceed retardates on both dimensions, in neither case did the difference reach significance.

Of the ten possible ways in which the six objects can be sorted into two groups of three, nine represent dimensional arrangements. In the OST, the tenth is a non-dimensional, random arrangement, termed the "blank sort." Analysis of variance in terms of the total number of blank sorts performed by subjects, summarized in Table 23, suggested a

TABLE 19

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF CORRECT CONVERGENT SORTS OF NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	3.60	2	1.80	3.86*
Within groups	15.37	33	.47	
Totals	18.97	35	est. ω^2 = .23	

$^*p \leq .05$

TABLE 20

GROUP MEANS AND STANDARD DEVIATIONS FOR NUMBER OF CORRECT CONVERGENT SORTS

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	12	1.92	.90	Groups I & II	2.31*
II (Retarded)	10	1.20	.42	Groups I & III	2.12*
III (Disturbed)	14	1.29	.61	Groups II & III	.36 NS

$^*p \leq .05$

TABLE 21

ANALYSIS OF VARIANCE OF CONVERGENT PHASE MEAN VERBALIZATION SCORES EARNED BY NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	24.49	2	12.25	7.42**
Within groups	54.48	33	1.65	
Totals	78.97	35	est. ω^2 = .34	

**p ≤ .01

TABLE 22

GROUP MEANS AND STANDARD DEVIATIONS FOR CONVERGENT MEAN VERBALIZATION SCORES

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	12	3.67	1.44	Groups I & II	3.97***
II (Retarded)	10	1.70	.67	Groups I & III	2.67**
III (Disturbed)	14	2.14	1.46	Groups II & III	.89 NS

**p ≤ .01
***p ≤ .001

significant difference ($F = 3.52, p \leq .05$). Group mean comparisons, summarized in Table 24, showed that both retarded and disturbed groups produced more blank sorts than did normals ($t = 2.27$ and 2.06, respectively, $p \leq .05$). Also, only six normal subjects, as compared to eleven disturbed and eighteen retarded subjects, produced such sorts. Those normals who produced such sorts averaged approximately one, disturbed subjects approximately two, and retardates three. Group identification was sufficient to account for twenty - three percent of the variance in blank sort production in the present sample.

In addition to executing a blank, nondimensional sort, a subject can perform erroneously on the OST by arranging the objects in a correct manner but explaining his sorting behavior in a totally incorrect way. A sort of this nature is termed a false positive sort, and comprises several forms of erroneous performance, distinguished by the nature of the verbal explanation. These sorts may be internal relational, external relational, primitive functional, or "sign" sorts. In each case, an invalid basis is given for sorting. In terms of one of the hypotheses, group differences were expected in the performance of false positive sorts as well

TABLE 23

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF BLANK SORTS PERFORMED BY NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	16.66	2	8.33	3.52*
Within groups	75.74	32	2.37	
Totals	92.40	34	est. ω^2 = .23	

*$p \leq .05$

TABLE 24

GROUP MEANS AND STANDARD DEVIATIONS FOR TOTAL NUMBER OF BLANK SORTS

Group	N	Mean	SD	Mean Comparison	t
I (Normal)	6	1.17	.41	Groups I & II	2.27*
II (Retarded)	18	3.00	1.94	Groups I & III	2.06*
III (Disturbed)	11	2.09	1.04	Groups II & III	1.43 NS

*$p \leq .05$

as blank sorts. However, as Table 25 shows, this variable yielded a very low, nonsignificant F-ratio, suggesting no important group differences.

One of the hypotheses concerned the number of duplicate sorts. However, for this variable, analysis of variance yielded a nonsignificant F-ratio as Table 26 shows. When the tendency to repeat a previously correct sorting arrangement with the same or a different verbalization was considered, no important intergroup differences were suggested.

Intergroup differences were also hypothesized in terms of the total number of sorts produced by subjects during the Divergent testing phase, regardless of correctness of these sorts. Positive sorts, false positives, duplicate sorts, and blank sorts would be included in this scoring dimension. Table 27 summarizes the analysis of variance for total number of Divergent sorts, which failed to suggest important differences between the groups.

Neither the analysis of variance for speed on the first sort, on which group differences were hypothesized, nor for mean sorting speed suggested statistically significant effects. These analyses are summarized in Tables 28 and 29. Other aspects of the scoring dimension of speed in sorting are considered subsequently.

TABLE 25

ANALYSIS OF VARIANCE OF NUMBER OF FALSE POSITIVE SORTS PERFORMED BY NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	1.98	2	.99	.57 NS
Within groups	65.82	38	1.73	
Totals	67.80	40		

TABLE 26

ANALYSIS OF VARIANCE OF NUMBER OF DUPLICATE SORTS PERFORMED BY NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	9.67	2	4.84	1.26 NS
Within groups	296.53	77	3.85	
Totals	306.20	79		

TABLE 27

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF ALL SORTS ON THE DIVERGENT PHASE OF NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	6.00	2	3.00	.21 NS
Within groups	1642.92	116	14.16	
Totals	1648.92	118		

TABLE 28

ANALYSIS OF VARIANCE OF SPEED ON THE FIRST SORT OF NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	821.78	2	410.89	2.24 NS
Within groups	20538.74	112	183.38	
Totals	21360.52	114		

TABLE 29

ANALYSIS OF VARIANCE OF MEAN SPEED OF SORTING OF NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	254.89	2	127.44	.55 NS
Within groups	26148.30	112	233.47	
Totals	26403.18	114		

In general, for the purpose of assessing the adequacy of performance on the OST, two of the preceding scoring indices would seem particularly salient. These are: (1) the total number of adequate (verbalized and non-verbalized) positive sorts performed during the Divergent phase, and (2) the mean verbalization score earned for the Divergent phase. The former can be regarded as an index of the presence of dimensional concepts in the cognitive matrix, the latter as an index of the level of sophistication of those concepts which are utilized in task performance. Although not specifically hypothesized, it seemed likely that if intergroup differences of a qualitative nature existed their presence might be suggested by the tendency for the above dimensions to be associated with different aspects of task performance and different subject characteristics. Table 30 presents the Pearson product-moment correlations obtained for each group between total number of adequate positive sorts and several other selected variables.

Total number of correct sorts did not appear to be associated with either age level or IQ level in any group, nor was it associated significantly with school achievement.

A high degree of statistical association between total number of adequate positive sorts and number of verbalized

TABLE 30

INTERCORRELATIONS OF TOTAL NUMBER OF ADEQUATE SORTS WITH AGE, IQ, ACHIEVEMENT, AND OTHER SELECTED OST VARIABLES IN NORMAL, RETARDED, AND DISTURBED GROUPS

Variable	Group I (Normal)	Group II (Retarded)	Group III (Disturbed)
Age	.06	.17	.10
IQ	.18	.01	.22
Reading Ach.	.10	-.12	.15
Arithmetic Ach.	.15	.09	.003
Total Ach.	.17	-.03	.12
No. Verbal. Pos. Sorts	.98**	.90**	.90**
Total No. All Div. Sorts	.60**	.40*	.54**
Mean Sorting Speed	.34*	.004	-.03
Verbal Discrepancy Score	-.43*	-.65**	-.38*
Mean Verbal. Score	-.02	-.04	.004
No. Duplicate Sorts	.38	-.02	.48**
No. Conv. + Div. Sorts	.61**	.74**	.63**
Flexibility Score	.72**	.88**	.24
No. Verbal. Categories	.94**	.84**	.86**

*$p \leq .05$
**$p \leq .01$

positive sorts was found in all three groups, this relationship being strongest among normals, only one of whom performed a nonverbal positive sort. Similarly, in all groups, correct sorting was positively related to the number of dimensional categories reflected in verbal justifications for sorting. Somewhat greater correspondence, however, was found for normal subjects, who may have tended to use these dimensions slightly more appropriately than did retarded and disturbed subjects.

An individual's flexibility score was based on the manipulative performance, rather than verbal, aspects of conceptual sorting. Although the objects varied on a total of nine particular dimensions, these dimensions can be classified as involving a single form attribute, a color attribute, or a combination of two or more form attributes. A high flexibility score reflects the tendency of an individual to shift frequently from one family of concepts (e.g., color concepts) to another set of concepts in sorting. A low score suggests the tendency either to exhaust all possibilities within a set of concepts before shifting to another or to use concepts belonging to only one family (e.g., unidimensional form concepts).

As Table 31 shows, the groups were not differentiated on the basis of the flexibility score itself. However, for normal and retarded subjects, this aspect of performance was very significantly associated ($r = .72$ and .88, respectively, both significant at the .01 level) with the number of adequate positive sorts executed. Among disturbed subjects, on the other hand, correct sorting was _not_ significantly correlated with dimensional shifting. Apparently, disturbed subjects tended to sort correctly through exhausting the possibilities within one of the three concept categories, whereas in the other groups correct sorting was more often associated with dimensional shifting.

When the relationship between correct sorting and the tendency to duplicate previously correct arrangements of the objects was considered, this relationship was found to be strongest in the disturbed group ($r = .48$, $p \leq .01$). For retardates, there was apparently no relationship between correct sorting and the performance of duplicate sorts, even though the number of retardates and disturbed subjects who performed duplicates was about the same.

A significantly greater number of retardates than normals duplicated previously correct sorts ($\chi^2 = 7.70$, $p \leq .05$).

TABLE 31

ANALYSIS OF VARIANCE OF FLEXIBILITY SCORES OF NORMAL, RETARDED, AND DISTURBED GROUPS

Source of variation	SS	df	MS	F
Between groups	.12	2	.06	.05 NS
Within groups	96.77	77	1.26	
Totals	96.89	79		

TABLE 32

NUMBER OF SUBJECTS IN NORMAL, RETARDED, AND DISTURBED GROUPS PERFORMING SORTS OTHER THAN CORRECTLY VERBALIZED SORTS*

		Frequency	
Type of Sort	Normal	Retarded	Disturbed
Nonverbal Positive	1	6	2
Duplicate	19	31	30
False Positive	11	18	12
Internal Relational	6	18	12
External Relational	1	12	8
Blank (Nondimensional)	6	18	11
"Sign"	1	9	3
Primitive Functional	0	1	0

*Several of the above types of sorts are varieties of false positive sorts.

when these two groups were directly compared. Disturbed subjects differed from normal in frequency of duplications to a slightly lesser extent ($\chi^2 = 6.36$, $p \leq .05$). Table 32 summarizes the frequencies with which members of each group performed sorts on the Divergent phase other than correctly verbalized positive sorts.

Among all groups, the sort most frequently replicated was the first in order of difficulty, the Angularity sort. However, among normals, there was a greater tendency to duplicate various sorts, rather than one particular arrangement. A contingency table was constructed for the three groups in terms of the frequency with which one particular sort was duplicated repeatedly, as compared to the frequency with which either no duplications were performed or ties were obtained. The greater tendency of both retarded and disturbed subjects to repeat one particular arrangement resulted in a χ^2 of 6.26, significant at the .05 level of probability. Table 33 compares the groups in terms of the frequencies with which certain sorting arrangements were duplicated.

Another way of considering differential tendencies to perform certain sorts rather than others is to list the frequencies with which subjects in each group performed the nine

TABLE 33

NUMBER OF NORMAL, RETARDED, AND DISTURBED SUBJECTS PERFORMING DUPLICATIONS OF PREVIOUSLY CORRECT DIMENSIONAL SORTS

Type of sort	Frequency		
	Normal	Retarded	Disturbed
1. Angularity	13	18	12
2. Hue	0	9	1
3. Transparency	2	1	8
4. Height	3	4	5
5.----9.	0	0	0

possible correct sorts, as is done in Table 34. The order of level of difficulty of the nine arrangements was previously determined empirically. If individuals performed the sorts in the order of their difficulty, group means should increase in magnitude as a function of increasing difficulty. If, however, order of sorting had no relationship with order of difficulty in a group, such correspondence would not be obtained. Table 34 shows, in addition to the frequencies with which sorts were performed in each group, means and standard deviations, with reference to positional order of execution. Group mean trends are also graphed in Figure 2.

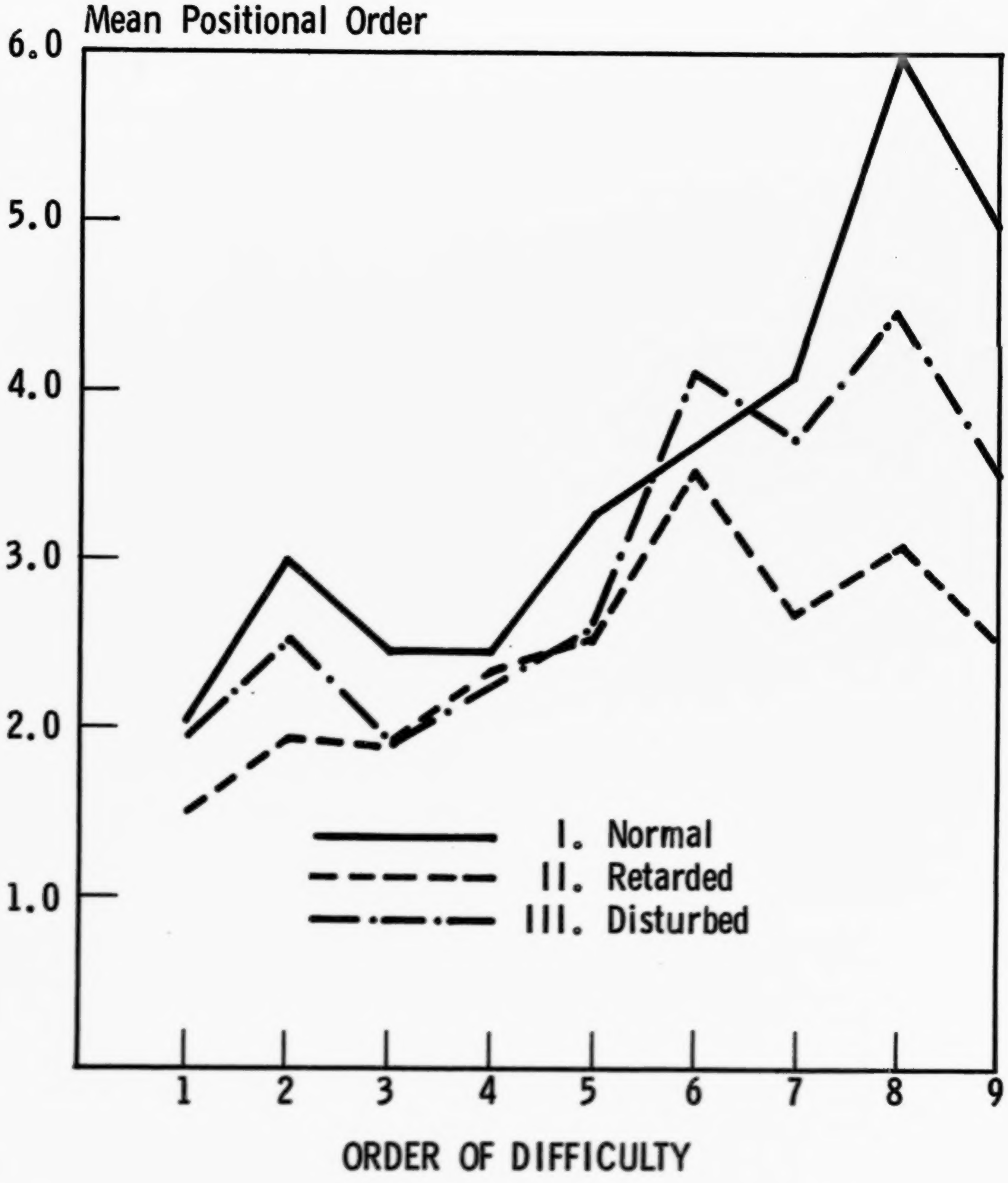
Table 34 shows that, on all but the two most difficult sorts, normal subjects exceeded both retarded and disturbed subjects in the frequency with which particular dimensional arrangements were executed. Not only did normals perform more correct sorts but, in general, they performed more of each possible type of correct sort. Disturbed subjects exceeded retardates in frequency of execution of all but the Volume sort and the Color Intensity sort, on the latter of which these groups were tied. In all three groups, the Angularity sort, first in order of increasing difficulty, was most frequently performed, although it was performed

TABLE 34

FREQUENCY OF INCIDENCE OF SORTS RANKED ACCORDING TO LEVEL OF DIFFICULTY IN NORMAL, RETARDED, AND DISTURBED GROUPS AND MEAN POSITIONAL ORDERING AND STANDARD DEVIATIONS FOR RANKED SORTS

Dimensional Attribute	N			Mean			SD		
	I	II	III	I	II	III	I	II	III
1. Angularity	33	24	30	2.0	1.5	2.0	1.2	.8	1.2
2. Hue	23	15	19	3.0	1.2	2.6	1.5	1.9	2.6
3. Transparency	32	15	19	2.5	1.9	2.0	1.5	1.4	2.6
4. Height	24	18	19	2.5	2.3	2.2	1.0	1.2	1.0
5. Perpendicularity	23	11	18	3.3	2.6	2.7	1.7	1.4	1.4
6. Equality of base axes	9	2	8	3.8	3.5	4.1	1.1	.7	1.9
7. Color intensity	8	7	7	4.1	2.7	3.9	1.4	1.0	1.8
8. Volume	1	11	5	6.0	3.1	4.4	.0	1.4	.6
9. Base area	1	3	6	5.0	2.7	3.7	.0	.6	1.9

FIGURE 2
Mean Order of Emergence in Normal, Retarded, and Disturbed Groups of Dimensional Sorts Ranked According to Increasing Level of Difficulty



significantly more frequently (χ^2=3.90, $p \leq .05$) by normals than by retardates. After this sort, the arrangement most frequently performed by normals was the Transparency sort, significantly less frequently executed by retardates (χ^2= 13.07, $p \leq .001$) and by disturbed subjects (χ^2= 7.59, $p \leq .01$).

In addition to correct sorting behavior, i.e., arranging the objects into dimensional categories representing polar opposites, the adequacy with which the individual explains his basis for sorting is also an important index of adequacy of conceptual behavior. As was noted earlier, a correct arrangement with erroneous verbalization, a "false positive" sort, is not scored for verbalization. An individual's total verbalization score is obtained by summing the scores assigned each "pole" of his explanation and then summing this pooled score over all positive sorts. The index derived in this way, however, would not be independent of the number of sorts performed correctly, the quantitative aspect of the individual's sorting performance. The mean verbalization score, derived by dividing total score by the number of correct sorts, provides a qualitative measure of level of conceptualization used in categorization.

Table 35 summarizes the intercorrelations between mean verbalization and other variables in each of the three groups. Mean verbalization score on the OST was positively associated with IQ and school achievement in the normal group, a finding consistent with results previously obtained by Safford and Dunn (1967) and by Safford (1967). However, in the case of both the retarded and the disturbed group, a small negative relationship was demonstrated between mean verbalization on the task and IQ and achievement or a low, nonsignificant positive relationship. Also, in the normal group, mean verbalization was significantly associated with the proportion of positive verbal sorts on the Divergent phase, whereas in the other groups this relationship was not statistically significant.

A difference between the retarded group and both others was suggested by the pattern of correlations between mean verbalization and total number of sorts performed and number of false positive sorts. Among normal and disturbed subjects in this sample, negative correlations ranging from very slight to significant ($p \leq .05$) were obtained. In retardates, however, mean verbalization was positively related to the execution of false positive sorts and, to a lesser and nonsignificant degree, to the total number of sorts performed.

TABLE 35

INTERCORRELATIONS OF MEAN DIVERGENT VERBALIZATION SCORES WITH AGE, IQ, ACHIEVEMENT, AND CERTAIN SELECTED OST VARIABLES IN NORMAL, RETARDED AND DISTURBED GROUPS

Variable	Group I (Normal)	Group II (Retarded)	Group III (Disturbed)
Age	.14	-.07	.06
IQ	.42**	-.05	.16
Reading Achievement	.35	-.32	-.11
Arithmetic Achievement	.34	-.20	-.18
Total Achievement	.37*	-.29	-.14
Proportion of positive verbal sorts	.33*	.11	.20
Verbal discrepancy score	-.13	-.10	-.36*
Total number of sorts (Divergent)	-.32*	.22	-.18
Number of false positive sorts	-.13	.62*	-.08

*$p \leq .05$
**$p \leq .01$

In all groups, verbal discrepancy scores were negatively associated with mean verbalization. However, in the disturbed group, this negative relationship reached significance ($p \leq .05$), suggesting that the average ability of disturbed subjects to explain the basis for their sorting suffered more than that of normal or retarded subjects from a tendency to describe one group or "pole" more adequately than the other.

Thus, in terms of average quality of verbalizations, retardates differed from normals and from disturbed subjects in that prolific, and erroneous, sorting was positively related to the quality of verbal justifications for sorting. Disturbed subjects differed slightly from normals and retardates in the strength of association between consistency or completeness of conceptualization and average quality of verbalization. Both groups differed from normals in that, among retarded and disturbed subjects, in contrast to normals, the level of conceptual sophistication revealed by mean verbalization scores was unrelated or negatively related to IQ level and achievement level.

Differential relationships between speed of sorting, or length of response latencies, were also hypothesized for the three groups. Sorting speed can be measured in terms of the average number of seconds required by a subject to complete a sorting arrangement on the Divergent testing phase. However, if response latencies can normally be expected to increase in length with increasing difficulty, as predicted, and normal subjects perform more correct sorts than, for example, retardates, this index would be biased in favor of the latter. That is, if information processing time increases as a function of increasing complexity or difficulty of the concepts involved, normals would appear to have longer response latencies as an artifact of their (hypothesized) more extensive cognitive matrices. Consequently, an alternative to mean speed as the relevant variable is speed on the first or on the second sort.

Table 36 shows the comparative speeds of normal, retarded, and disturbed groups on each correct execution, together with the frequencies with which subjects in each group performed one, two, three, or more correct sorts. Only four normals, no retardates, and two disturbed subjects performed more than five correct sorts. Trends in response latency, i.e., time required to execute sorts, are graphically presented in Figure 3. The differences in performance characteristics with respect to trends in speed of sorting suggested in Figure 3 are discussed subsequently in the present chapter.

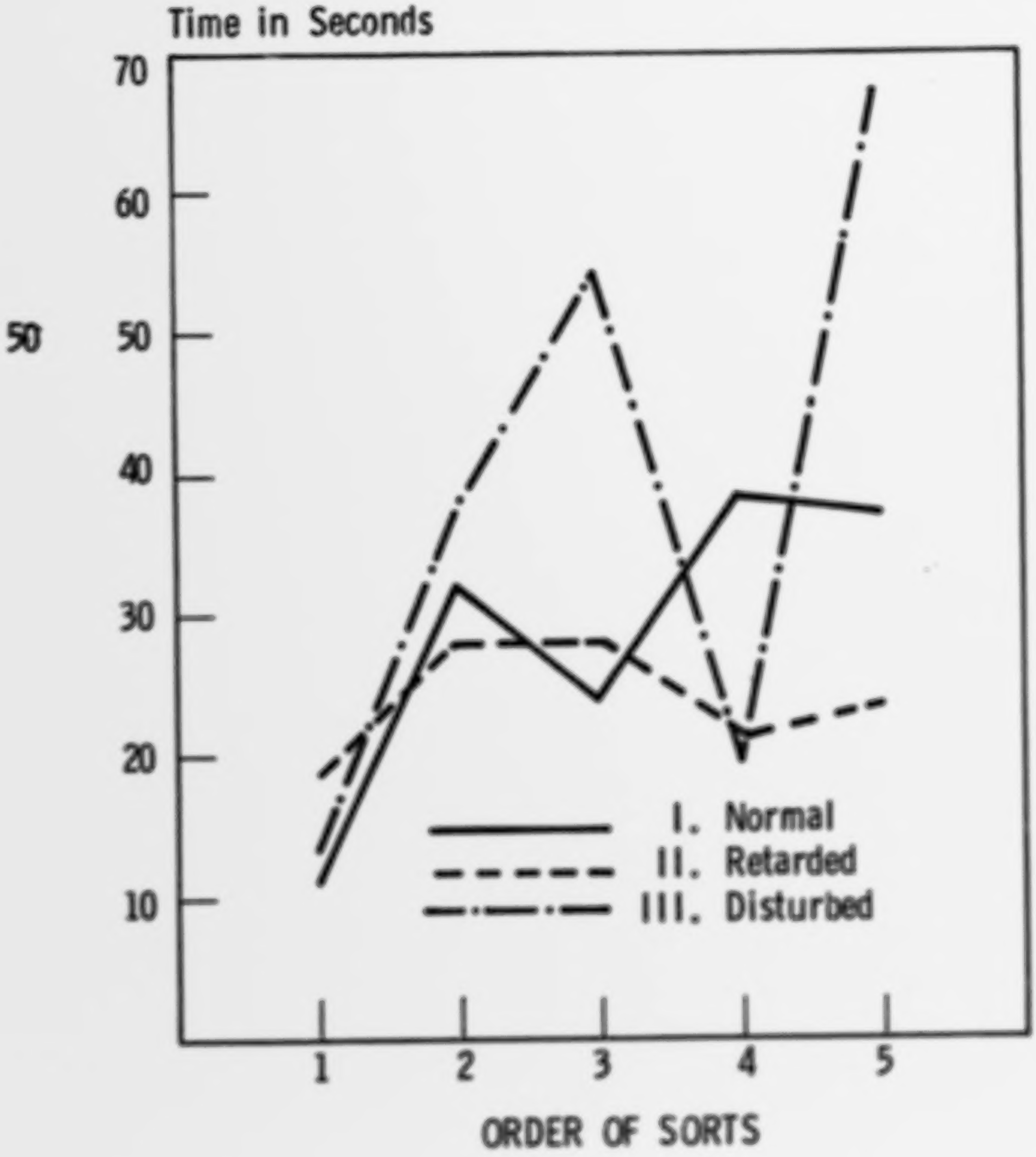
TABLE 36

MEAN SORTING SPEEDS AND STANDARD DEVIATIONS OF NORMAL, RETARDED, AND DISTURBED GROUPS

Sorts Executed	N I	N II	N III	Mean I	Mean II	Mean III	SD I	SD II	SD III
1st	39	36	40	11.7	18.0	13.2	9.9	14.9	15.2
2nd	35	20	29	32.5	27.8	37.2	83.4	26.0	110.9
3rd	31	12	20	24.0	28.5	54.5	35.1	13.8	129.9
4th	21	4	14	37.9	22.0	19.7	35.7	15.2	11.5
5th	12	2	2	37.4	23.0	67.0	32.9	1.4	8.5
6th	3	0	2	----	----	----	----	----	----
7th	1	0	0	----	----	----	----	----	----
8th	0	0	0	----	----	----	----	----	----

I = Normal group
II = Retarded group
III = Disturbed group

FIGURE 3
Mean Sorting Time in Seconds of
Normal, Retarded, and Disturbed Groups



In terms of mean sorting speed, a high degree of variability was found in all three groups, resulting in a nonsignificant F-ratio (See Table 29). However, as Table 37, shows, when the relationship between adequacy of performance on the task, as indicated by the number of correct sorts, and mean sorting speed was considered, differential relationships between these indices were found among the three groups. In normals, long latencies were positively related to performing a greater number of positive sorts. In the retarded and disturbed groups, on the other hand, there was no association between mean sorting speed and extensiveness of correct sorting. However, in both special groups, but not in the normal group, long response latencies were positively correlated with the performance of a higher proportion of positive sorts to the total number of sorts executed. Apparently, slow-working, correctly-performing normals tended to produce other types of sorts as well, such as duplicate sorts. Slow-working retarded and disturbed subjects, on the other hand, may have been less prolific and ingenious, but tended to perform a comparatively few sorts correctly.

TABLE 37

INTERCORRELATIONS OF OST SORTING SPEED DIMENSIONS AND OTHER SELECTED OST VARIABLES IN NORMAL, RETARDED, AND DISTURBED GROUPS

Correlated variables	Group I (Normal)	Group II (Retarded)	Group III (Disturbed)
Mean Sorting Speed:			
1. No. Pos. Verb. Sorts	.37*	-.09	-.003
2. Total No. Pos. Sorts	.34*	.004	-.03
3. Total No. Sorts (Div.)	.13	-.33*	-.25
4. Proportion Pos. Sorts	.02	.57**	.38*
5. No. Verb. Categories	.39*	-.13	.01
6. Speed First Sort	.52**	.66**	.77**
7. Speed Second Sort	.42*	.86**	.59**
Speed on First Sort:			
1. Speed Second Sort	-.10	-.06	-.14
2. Verb. Discrepancy	.01	.42*	-.04
Speed on Second Sort:			
1. No. Pos. Verb. Sorts	.32*	-.32*	-.22

*$p \leq .05$
**$p \leq .01$

Summary of Results Pertaining to the Hypotheses

The results concerning the hypotheses may be summarized as follows:

General Hypothesis I

This hypothesis predicted that the concept-formation, concept-recognition performance of emotionally disturbed children on the Object Sorting Task would differ from that of normal children in certain respects but not in others. Differences were predicted in qualitative, but not quantitative, dimensions of cognitive functioning. This hypothesis of qualitative difference of functioning was cast in operational terms through predictions concerning several specific OST scoring dimensions.

Operational Hypothesis A: Emotionally disturbed subjects will perform more erroneous sorts. The results of analysis of variance on the performance of blank, i.e., nondimensional, sorting arrangements suggested the presence of intergroup differences. The overall F-ratio differentiated the three groups to the extent that twenty-three percent of the variance in blank sort performance could be accounted for by group identification. However, retardates differed more from normals in terms of this dimension than did disturbed subjects. Eighteen retardates, compared to eleven disturbed and only six normal subjects, performed blank sorts, and of those individuals who did so, retardates performed significantly more than normals. The average number of blank sorts performed by the disturbed group, however, was also significantly greater than the normal group mean.

Analysis of variance of the execution of false positive sorts, correct dimensional sorts with incorrect verbal justifications, suggested no group differences in this form of erroneous sorting. However, more retarded subjects than either disturbed or normal performed false positive sorts, the frequencies being eighteen, twelve, and eleven, respectively. On the other hand, of those subjects in the sample who did execute such sorts, those in the disturbed group did produce more (2.2) than either retardates (1.7) or normals (1.6), thus offering some mild and nonsignificant support for the hypothesis.

Operational Hypothesis B: *Emotionally disturbed subjects will perform more duplicate sorts*. As predicted, significantly more ($p \leq .01$) disturbed subjects than normals performed duplicate sorts, but the difference between retardates and normals in this respect was slightly greater. Counter to prediction, among those individuals who did duplicate previously correct sorts, the mean incidence of such sorts was highest for the normal group. None of the intergroup differences reached significance, however.

Operational Hypothesis C: Order of emergence of sorts will be unrelated to order of difficulty for emotionally disturbed subjects. If an individual performed all nine possible correct sorts, and performed them in order of increasing level of difficulty, as cognitive matrix theory would predict, he would first perform the Angularity sort, second the Hue sort, third the Transparency sort, etc., in the order in which they are listed in Table 34. However, few subjects in the entire sample executed more than five correct sorts. Thus, in interpreting the graphs in Figure 2, little confidence can be placed in the representation of trends beyond the fifth sort performed. As these graphs suggest, little difference among the groups was found in terms of order of emergence of sorts, and all groups departed slightly from the theoretical prediction of linearity. Some suggestion of support for the hypothesis, though insufficient to warrant exploration via statistical means, was found in the disturbed group in terms of the high degree of variability with which this group ordered the particular sorts, somewhat higher than that of the normal or retarded group.

Operational Hypothesis D: The emotionally disturbed group will have greater intragroup variability on all task dimensions. As noted above, disturbed subjects were more variable than either normals or retardates in order of sort execution. The standard deviation of this group was greater in magnitude than that of the normal group in the distributions for mean sorting speed, mean verbalization, conceptual flexibility, and number of false positive sorts. The SD's of the two groups for number of adequate positive sorts, number of duplicate sorts, total number of all Divergent sorts, proportion of adequate positive sorts, mean verbal discrepancy, and number of conceptual verbalization categories were about equal or in some cases larger for the normal group, however. In addition, retardates were more variable than disturbed subjects on several dimensions, such as mean verbalization. Thus, little support was provided by the data for this hypothesis. More impressive was the high degree of variability in performance found in all three groups.

Operational Hypothesis E: Speed of sorting will remain relatively constant throughout the task for emotionally disturbed subjects, (but not for normal or retarded subjects). Cognitive matrix theory predicted that, for normal children, the time required for data processing should increase as concepts in the matrix become less accessible for utilization. Thus, if sorts are performed in order of their accessibility, or level of difficulty, under normal circumstances the length of time required for sorting should increase with each successive execution. The hypothesis was based on the expectation that, among emotionally disturbed children, remote and often invalid associations are as likely to be elicited as are more obvious and correct conceptual associations. Therefore, for disturbed subjects, ease or difficulty of a sort was predicted to be unrelated to the time required to perform the sort. All sorts executed by these individuals were predicted to be performed at a relatively constant rate of speed, when compared to normal subjects.

Response latencies in performing each successive sort were graphed in Figure 3. As these graphs suggest, speed of sorting in disturbed subjects, far from being constant, was considerably more variable than in either normal or retarded subjects. Futhermore, at only one point, the fourth sort, did the disturbed group perform more rapidly than normals. On all other sorts, length of time required to sort was greater for disturbed subjects than for normals. Thus, as predicted, whereas normal subjects adhered rather closely although not perfectly to the predicted trend, disturbed subjects did not. However, the nature of the difference between these groups in terms of sorting speed trends ran counter to the prediction of constancy versus linearity. In fact, retardates performed more closely in this respect to the manner predicted to characterize disturbed individuals.

Operational Hypothesis F: Emotionally disturbed subjects will perform more "sign" sorts and "primitive functional sorts. This hypothesis was formulated on the strength of the assumption, supported by the literature, that the cognitive performance of emotionally disturbed children is disrupted by affective factors. Although the stimulus objects used in the OST were "non-meaningful," it seemed conceivable that meaning could be attributed to them. That is, the objects could be perceived by a subject as symbolizing or representing something, or as capable of volitional behavior, possibly of an agressive nature. Conceptual behavior of this type was expected to occur more frequently among disturbed than among normals subjects.

Table 32 showed the frequencies with which particular kinds of sorts, other than correctly verbalized positive sorts, occurred. Only three subjects in the disturbed group provided verbal explanations of sorts suggesting that meaning was attributed to the objects, i.e., that they represented something, compared to one normal subject. In the retarded group, however, nine subjects verbalized sorts in such a manner. Only one subject, a retardate, in the entire sample rationalized sorting performance in "primitive functional" terms. Thus, no support for the hypothesis was obtained.

Summary. In general, the tendency to sort erroneously was greater among retardates than among disturbed subjects, but more false positive sorts were performed by the latter. The number of subjects in the disturbed and retarded groups who performed duplicate sorts was about the same, and this number was significantly greater than the number of normal subjects who duplicated. However, those who did replicate sorts did so more frequently than did either disturbed or retarded subjects. Disturbed subjects were more variable, as predicted, on some task dimensions, such as mean speed and mean verbalization score, but less so than normals on several others, such as number and proportion of positive sorts, etc. As predicted, length of response latency did not correspond to presumed level of difficulty among disturbed subjects, but differed in a manner which ran counter to prediction. Finally, disturbed subjects in this sample did not tend to attribute meaning to the stimulus objects.

General Hypothesis II

This hypothesis predicted that, unlike emotionally disturbed children, mentally retarded children would differ only quantitatively from normal subjects in performance on the OST.

Operational Hypothesis A: Mentally retarded subjects will perform fewer positive sorts. The retarded and normal groups were, as predicted, sharply differentiated in terms of the number of correct sorts performed. The mean number of verbalized positive sorts performed by retardates was less than two, as compared to about three and one-half performed by normals, a difference significant well beyond the .001 level of probability. When verbalized and nonverbal positive index, the difference was slightly reduced but still attained the same level of significance. Retardates also performed significantly fewer positive sorts than did disturbed subjects, although performance in the latter group was still less adequate than that of the normal group.

Operational Hypothesis B: *Mentally retarded subjects will have lower mean verbalization scores*. Retardates did differ very significantly (p = .001) from normals in mean verbalization, thus supporting the hypothesis. Disturbed subjects, however, differed from normals to about the same degree.

Operational Hypothesis C: *First sort reaction time will be longest for mentally retarded subjects*. This variable failed to produce a significant effect (F = 2.24, about 3.08 required for significance at the .05 level) in differentiating the groups. However, the mean time required to complete the first sort was greater for retardates (18.03) than for normals (11.67) or disturbed subjects (13.15). A high degree of intragroup variability, especially in the two special groups, accounted for the failure of first sort speed to produce a significant effect. On the second sort performed, moreover, retardates performed significantly more *rapidly* and with less variability than did normals or disturbed subjects. The trends in speed of execution of each successive positive sort, presented in Figure 3, suggested that retardates tended to sort more rapidly and with less variability than did either of the other two groups.

Operational Hypothesis D: The total number of sorts performed by mentally retarded subjects will be less. As Table 27 shows, the groups were not differentiated on the basis of the total number of sorts, including positive, duplicate, false positive, and blank sorts, performed during the Divergent phase. The hypothesis was formulated on the basis of the assumption that retardates would have fewer concepts available in the cognitive matrix for utilization, regardless of the appropriateness of the concepts. A high degree of intragroup variability was found to characterize all three groups, precluding the possibility of a significant effect. The mean total number of all types of sorts performed by retardates was, in fact, somewhat greater than that performed by normals (6.3 and 6.0, respectively), and disturbed subjects were only slightly more prolific, averaging 6.5 sorts. Thus, the data provided no support for this hypothesis.

Operational Hypothesis E: Although mentally retarded subjects will perform fewer positive sorts, the order of emergence of these sorts will be related to the order of their difficulty. As figure 2 suggests, the order of appearance of sorts did adhere fairly closely to the predicted trend, among retardates as among normals. That is, retardates did tend to perform sorts roughly in order of their difficulty up to the sixth sorts. However, several retardates executed difficult sorts, especially the Volume sort which ranks eighth in order of difficulty, without executing the preceding dimensional arrangements of the objects.

Summary. The first two hypotheses were strongly supported by the data. Retardates did perform fewer correct sorts and earned lower mean verbalization scores than did normals. However, retardates performed a relatively greater total of number of all types of sorts than had been hypothesized and performed correct sorts more rapidly and at a more constant rate of speed than had been expected. Finally, although order of appearance of particular sorts corresponded fairly well with order of their difficulty, some variability was seen in the frequency with which difficult sorts were executed without prior appearance of easier sorts.

Results Obtained Through Other Forms of Analysis of the Data

A matter of concern in such an investigation as the present study is the question of relevance of the behavior being investigated. In earlier discussions pertaining to the rationale of the Object Sorting Task and the theory of cognitive structure and function from which it was generated, this question was given intensive consideration. Previous exploratory studies with the OST have suggested that, in normal and bright children, the task elicits performance of the nature required in IQ test and, for example, measures of creative thinking. Positive significant correlations have been found between OST scores and both IQ and creativity test battery scores. (Safford, 1967). In addition, task indices have been demonstrated to have a significant predictive relationship between performance on the task and the actual conceptual performance of school children.

In the present investigation, a milder but significant correlation was obtained for the normal group between OST mean verbalization scores on the Divergent phase and total academic achievement. ($r = .37$, $p = .05$). When this scoring dimension was combined with mean Convergent verbalization, a multiple correlation of .62 was obtained (df = .10, p = .05). In terms of magnitude of the correlation coefficient, this was exactly equal to the high correlation between IQ and total achievement in the normal group. However, because of the greatly reduced N with which the OST-achievement correlation was obtained, the same level of significance as that of IQ-achievement correlation (p = .01) was not attained.

When both IQ and mean Divergent phase verbalization were combined, the degree of relationship with total achievement was slightly enhanced in the normal group (R = 65). In retardates, IQ was less strongly related to achievement (r = .43, p = .05) and was not enhanced as a predictor by the addition of mean verbalization, which was mildly negatively associated with achievement in this group. In the disturbed group, neither IQ nor mean OST verbalization was significantly associated with academic achievement, although this group was very similar to the normal group in both IQ and achievement characteristics.

The OST scoring dimension of the number of correct verbalized and nonverbal positive sorts on the Divergent phase was not significantly correlated with IQ or achievement in any of the three groups. Correct concept recognition on the Convergent phase was more highly correlated, although these correlations were nonsignificant due to the small N's in the Convergent phase measures. However, when a multiple correlation coefficient of number of Divergent positive sorts with mean verbalization score on the Divergent phase with total academic achievement was computed, it attained significance at the .01 level (R = .42) for the normal group. For the disturbed and retarded groups, combination of variables which were negatively related or unrelated to achievement, as measured by standardized test batteries, did not substantially improve the relationship.

However, the correlation of IQ with achievement was greatly reduced in the retarded and in the normal group when number of positive sorts was partialled out. These partial correlations were .10 for normals and .02 for retardates. In the disturbed group, however, the fairly low relationship between IQ and achievement was not greatly affected by partialling out number of positive sorts on the OST. The partial correlation coefficient obtained was .20, in comparison to .23 before the OST variable was partialled out. IQ itself accounted for only five percent of the variance in school achievement among disturbed subjects, and without removing correct OST sorting still accounted for only eight percent.

Several of the findings of the analyses of the data in terms of the hypotheses suggested the presence of a high degree of variability in the performance of all three groups. In addition, in many respects, the performance of retardates and disturbed subjects was apparently quite similar. The possibility was considered that these similarities might be found among some but not all members of the special groups. In order to explore this possibility, a computer program of cluster analysis was used which assigned subjects to groups on the basis of high "similarity coefficients" on the relevant variables. These variables, for the purpose of this analysis, were all OST scoring indices, age, and IQ.

Three aspects of this form of analysis were suggestive. First, the composition of these high-similarity clusters was in itself of interest. The largest cluster, comprising nearly half of the special class subjects, was predominantly composed of retarded subjects. The next largest cluster was entirely made up of disturbed subjects. A small cluster was also exclusively retarded in composition. The other two clusters were about equally divided. Table 38 summarizes the composition of the five clusters. One emotionally disturbed subject remained an isolate. The three retarded and eleven disturbed subjects not included in this analysis presented scores not amenable to cluster analysis (the scores were interpreted by the program as missing data) or had to be excluded due to actual missing data.

Comparisons of group means of these clusters on selected OST variables, although not uniformly yielding significant group differences, was of interest in itself. These group mean comparisons are graphically represented in Figure 4.

Analysis of variance did reveal, however, that these cluster groups were markedly differentiated on the basis of IQ (F = 8.32, p = .01) as Table 39 shows. Cluster identification accounted for nearly one-third of the variance in IQ. In terms of correct sorting, however, a very small cluster greatly exceeded all others, most notably a group (Cluster 3) comprising both, which ranked third in IQ. Analysis of variance results and specific

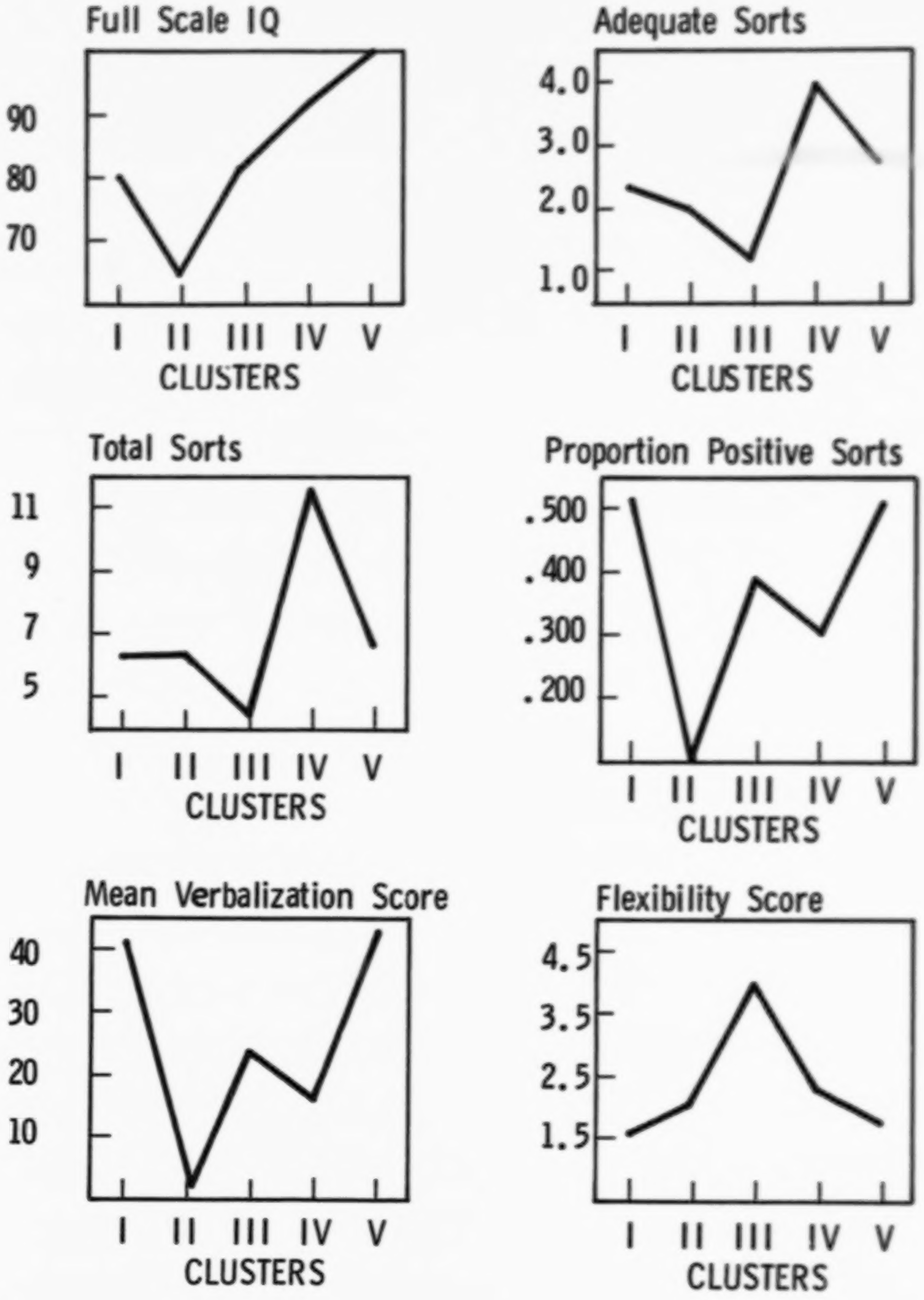
TABLE 38

COMPOSITION OF FIVE GROUPS OF SPECIAL CLASS FOUND THROUGH CLUSTER ANALYSIS TO HAVE HIGH SIMILARITY COEFFICIENTS

Group	Total	N Retarded	Disturbed	Percentage Retarded	Disturbed
Cluster I	32	25	7	78 %	22 %
Cluster II	5	5	0	100 %	0 %
Cluster III	10	6	4	60 %	40 %
Cluster IV	3	1	2	33 %	67 %
Cluster V	15	0	15	0 %	100 %
Totals	65	37	28	57 %	43 %

FIGURE 4

COMPARISON OF GROUP MEANS OF FIVE SPECIAL CLASS SUBJECT CLUSTERS ON IQ AND SELECTED OST VARIABLES



Full Scale IQ

Adequate Sorts

Total Sorts

Proportion Positive Sorts

Mean Verbalization Score

Flexibility Score

mean comparisons for number of positive sorts are presented in Tables 41 and 42. Comparable summaries in terms of number of verbalization categories employed are provided in Tables 43 and 44.

The OST mean verbalization score index was not replicated in one cluster (Cluster 2) Therefore, analysis of variance was not carried out. Table 45 summarizes the means and standard deviations of the cluster distributions of mean verbalization scores and reports those intergroup t-ratios which reached an acceptable level of significance. Analysis of variance of mean sorting speed indicated that no significant group differences existed in terms of length of response latency, i.e., speed in performing the sorts,as Table 46 shows.

The overall picture presented by the cluster analysis seemed most striking when the graphs in Figure 4 were viewed with knowledge of the composition of the clusters. It seemed apparent that, although IQ was an important factor in all aspects of task performance, differential relationships between IQ and these same variables characterized the clusters. For example, Cluster 1, which had a mean IQ of 80 performed relatively much higher on mean verbalization than on production of correct sorts. In Cluster 4, with a mean IQ of 92, this pattern was reversed. Cluster 3, highest in Flexibility score and intermediate in most other respects, was lowest of the groups both in total sort execution and in performance of adequate sorts. These three clusters included both retarded and disturbed subjects.

Implications of these suggestive findings and of this form of analysis, as well as general conclusions of the study, are discussed in the concluding chapter.

TABLE 39

ANALYSIS OF VARIANCE OF FULL SCALE IQ SCORES OF FIVE SPECIAL CLASS SUBJECT CLUSTERS

Source of variation	SS	df	MS	F
Between groups	6216.49	4	1554.12	8.32**
Within groups	11209.11	60	186.82	
Totals	17425.60	64	est. ω^2 = .31	

**p = .01

TABLE 40

GROUP MEANS AND STANDARD DEVIATIONS OF FIVE SPECIAL CLASS SUBJECT CLUSTERS FOR FULL SCALE IQ

Group	N	Mean	SD	Mean Comparison	t
Cluster V	15	99.7	13.9	Clusters I & II	2.60**
Cluster IV	3	92.0	23.5	Clusters I & V	4.66***
Cluster III	10	82.3	14.6	Clusters II & III	2.51*
Cluster I	32	80.3	13.0	Clusters II & IV	2.49*
Cluster II	5	64.6	7.9	Clusters II & V	5.30***
				Clusters III & V	3.01*

*p = .05
**p = .01
***p = .001

TABLE 41

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF ADEQUATE POSITIVE SORTS PERFORMED BY FIVE SPECIAL CLASS SUBJECT CLUSTERS

Source of variation	SS	df	MS	F
Between groups	24.67	4	6.17	4.82**
Within groups	72.88	57	1.28	
Totals	97.55	61	est. ω^2 = .20	

**p = .01

TABLE 42

GROUP MEANS AND STANDARD DEVIATIONS FOR FIVE SPECIAL CLASS SUBJECT CLUSTERS FOR TOTAL NUMBER OF ADEQUATE POSITIVE SORTS

Group	N	Mean	SD	Mean Comparison	t
Cluster IV	3	4.00	.00	Clusters I & III	2.79**
Cluster V	15	2.80	1.26	Clusters I & IV	2.34*
Cluster I	32	2.31	1.23	Clusters II & IV	2.68*
Cluster II	2	2.00	1.41	Clusters III & IV	11.15***
Cluster III	10	1.20	.42	Clusters III & V	3.84***

*p = .05
**p = .01
***p = .001

TABLE 43

ANALYSIS OF VARIANCE OF NUMBER OF DIMENSIONAL VERBALIZATION CATEGORIES USED BY FIVE SPECIAL CLASS SUBJECT CLUSTERS

Source of variation	SS	df	MS	F
Between groups	24.02	4	6.00	4.04**
Within groups	86.30	58	1.49	
Totals	110.32	62	est. ω^2 = .16	

**p = .01

TABLE 44

GROUP MEANS AND STANDARD DEVIATIONS FOR FIVE SPECIAL CLASS SUBJECT CLUSTERS ON NUMBER OF DIMENSIONAL VERBALIZATION CATEGORIES

Group	N	Mean	SD	Mean Comparison	t
Cluster V	15	3.13	1.58	Clusters I & II	1.90*
Cluster IV	3	2.67	.58	Clusters I & III	2.36*
Cluster I	32	2.38	1.24	Clusters I & V	1.80*
Cluster III	10	1.40	.70	Clusters II & IV	5.00**
Cluster II	3	1.00	.00	Clusters II & V	2.32*
				Clusters III & IV	2.84**
				Clusters III & V	3.30**

*p = .05 **p = .01 ***p = .001

TABLE 45

GROUP MEANS AND STANDARD DEVIATIONS OF MEAN VERBALIZATION SCORES OF FIVE SPECIAL CLASS SUBJECT CLUSTERS

Group	N	Mean	SD	Mean Comparison	t
Cluster V	15	4.37	1.26	Clusters I & II	3.53***
Cluster I	32	4.01	1.04	Clusters I & III	4.22***
Cluster III	10	2.45	.96	Clusters I & IV	3.96***
Cluster IV	3	1.60	.35	Clusters II & III	2.14*
Cluster II	1	.30	.00	Clusters II & IV	3.25*
				Clusters II & V	3.13**
				Clusters III & V	4.09***
				Clusters IV & V	3.70***

$*p \leq .05$ $**p \leq .01$ $***p \leq .001$

TABLE 46

ANALYSIS OF VARIANCE OF MEAN SORTING SPEED IN FIVE CLUSTERS OF SPECIAL CLASS SUBJECTS

Source of variation	SS	df	MS	F
Between groups	332.30	4	83.08	.29 NS
Within groups	16592.54	57	291.10	
Totals	16924.84	61		

VII. Conclusions and Implications

In the present study, an attempt was made to predict the patterns of performance of emotionally disturbed and mentally retarded children on a categorization task in terms of a theory of cognitive structure and function. A sample of disturbed and of retarded children was selected from their respective public school special class populations, and the task performance of these children was compared to that of a group of children in normal class placement. Hypotheses were formulated in terms of predicted similarities and differences between the functioning of each group and that of the normal sample. The data provided some support for several of the hypotheses, but in the case of some others the findings were inconclusive or failed to provide confirmation.

In general, it was found that, as hypothesized, this group of mildly mentally retarded children did differ from normal subjects in quantitative respects. In terms of the theory, these children appeared to have at their disposal fewer concepts and conceptual dimensions for utilization in task performance. On nearly all quantitative indices, as was summarized in the preceding chapter, these subjects received lower scores than children representing normal school placement.

The emotionally disturbed sample, although roughly equated with the normal group in IQ, also performed less adequately on the quantitative task indices than normals, however. On several such dimensions, this group appeared to occupy an intermediate position between the normals and retardates, significantly lower than the former and significantly higher than the latter.

It was hypothesized that retarded subjects would have at their disposal fewer concepts and fewer conceptual dimensions, and that these would not be as readily available for use in task performance. However, those concepts and conceptual dimensions which were present were expected to be similar to those contained in the cognitive matrices of normal children. For disturbed subjects, on the other hand, size of the cognitive matrix was not expected to differ from that of the normal children of about the same age and IQ level. Deficits in performance were hypothesized for qualitative, rather than quantitative, aspects of task performance. In other words, disturbed children were expected to differ in nature, rather than number, of concepts and conceptual dimensions present in the cognitive matrix and utilized in task performance.

It was found that, as predicted, the retarded subjects in the present sample did differ significantly from the normal subjects in the number of concepts reflected in task performance and in the level of sophistication of these concepts. However, counter to prediction, these subjects sorted more, rather than less, prolifically when all types of sorts, including erroneous sorts, were considered, and more rather than less rapidly than normal subjects. Futhermore, the presence of qualitatively different concepts and conceptual dimensions in the retarded group was very suggestive of qualitative differences between normals and retardates in this sample in cognitive structure.

Counter to the hypothesis, very little bizarre or idiosyncratic conceptualization was found in the task performance of disturbed subjects. Comparatively more disturbed subjects than normals performed duplicate and erroneous sorts, but generally even more retardates performed such sorts. Rather than suggesting either uniformly "impulsive" behavior or equal accessibility of concepts, regardless of validity, information processing time required in sorting was greater than predicted and highly variable. In general, although the performance of the disturbed subjects did differ qualitatively from that of normals in several respects, the performance of retardates was even more divergent along many of these same dimensions.

Both groups differed markedly from the normal group in several important ways. Whereas among normals both IQ and dimensions of cognitive performance measured by the OST were significantly associated with academic achievement, the degree of relationship between these same variables and school achievement was considerably less and in no case statistically significant among disturbed subjects. Among retardates, only the correlation between IQ and achievement reached significance, but at a lower level than was the case for normals. For retardates, no important relationship between any aspect of task performance and achievement was found. As was pointed out earlier, however, the lack of uniformity of source of achievement data may have been an attenuating factor.

For normal and for disturbed subjects, adequacy of sorting was mildly and nonsignificantly associated with

IQ. Among retardates, however, these were totally unrelated. Both special class groups differed markedly from normals in that for disturbed and retarded subjects mean verbalization was unrelated or negatively related to IQ and achievement, especially for the latter group. Finally, among normals, long response latencies were significantly associated with correct sorting. In the other two groups, however, no association between sorting speed and sorting accuracy or adequacy was found.

One suggestive finding, which was consistent with other research evidence cited in Chapter III, was that retardates, more often than normal or disturbed subjects, were able to sort correctly but were unable to provide a verbal explanation of the basis for their sorting behavior. This observation, coupled with the finding of very significant differences between retardates and normals in mean verbalization score, is suggestive of a general deficit in aspects of the task requiring verbal performance. Perhaps observations of such developmental theorists as Piaget, Bruner, and Werner concerning nonverbal or preverbal modes of cognitive representation may prove especially useful in attempting to interpret and predict the intellective or cognitive behavior of mentally retarded individuals. Such measures as the OST, in providing indices of conceptualization which are to some degree independent of language, may be better suited to the task of assessing the capabilities of retardates than the commonly used measures of IQ. The possibility that IQ level may have been a unifying factor in the determination of verbal performance on the task for all groups in the present investigation would seem to be contra-indicated. Retardates appeared generally to have performed better in terms of those task indices pertaining to manipulative conceptual sorting than on those indices which involved verbal performance. In addition, disturbed subjects, equated with the normal group on IQ, were significantly lower than normals on mean verbalization score.

Analysis of the data obtained yielded a number of findings which offered support for the general hypothesis of qualitative differences between emotionally disturbed and normal subjects. However, the specific evidences of these differences were not uniformly found in the form hypothesized. Rather, they often took the form of differential relationships within the groups of the cognitive variables investigated. For disturbed children, neither

IQ level nor the conceptual indices of OST performance were substantially related to achievement in school. Among normal children, however, school achievement may have been more clearly a "cognitive matter." Apparently, for children who are emotionally handicapped, at least in the present sample, factors other than cognitive variables play an important role in the determination of success in school learning.

As evidenced by earlier discussion in Chapters III and IV, categorization tasks have often been used in the measurement of conceptual behavior. A number of these tasks have involved object sorting, and can be distinguished in terms of the nature of the objects to be grouped as involving "meaningful" or "non-meaningful" stimulus objects. Some reports in the literature have suggested that conceptual behavior of disturbed children might be adversely affected only if meaningful, personalized, or "affect-charged" stimuli are involved. It seems possible that the abstractness or "non-meaningfulness" of the OST materials might account to some unknown extent for the lack of differentiation between disturbed and other subjects in the present study in the production of bizarre or idiosyncratic responses.

One implication for further research, therefore, would be that the performance of disturbed subjects on the OST and a "meaningful" categorization task could be compared, provided that baseline performance patterns of normal children on both tasks are also known. It is also possible, in light of the several instances of qualitative differences between normal and retarded performances found in the present study, that such a comparison might be instructive with regard to retardates.

Another possible avenue for the exploration of conceptualization in emotionally disturbed children with the OST would be to compare the performance of schizophrenic children with a sample of public school special class disturbed subjects. If the latter group can be expected to comprise, for the most part, acting-out neurotic children, comparison of these groups might suggest that bizarre or idiosyncratic conceptualization is a function of the nature or severity of the disturbance, rather than of emotional disturbance itself.

In attempting to account for the lack of differentiation between disturbed and retarded group means on several OST scoring dimensions, the application of cluster analysis was highly suggestive. Although this form of analysis was conducted on only an exploratory basis in the present investigation, it did yield evidences of areas in which there was overlapping between the two special groups. One of the clusters, all of whose members were disturbed subjects, performed in a manner somewhat closer to that predicted for the entire sample of emotionally disturbed subjects than did that group as a whole. A large cluster, made up of retardates and low-IQ disturbed individuals, performed quite close to the manner predicted for the retarded group as a whole.

In all five clusters, however, particular patterns of interrelationships between cognitive variables were found. It was strongly suggested that each group manifested an individual performance pattern in terms of conceptual functioning which might be used as a basis for instructional grouping. To determine precisely what the particular characteristics of these clusters were would require more intensive study of the data and the collection of additional data. A further implication of the present study, then, is that cluster analysis may offer a means of assigning subjects to groups on the basis of commonalities of cognitive characteristics. The purpose of such groupings might conceivably relate to academic instruction, therapy, or psychological research. In each case, the criteria for assigning individuals to groups might be more valid than those presently applied in public schools and treatment or custodial institutions. The fact that three of the five clusters obtained in this study, even with reduced N's, comprised both retarded and disturbed special class subjects may have implications for differential diagnosis and for programming.

Another form which cluster analysis could take in subsequent research of this nature would relate to affective variables and their effects on cognitive performance on the task. Once clusters are identified on the basis of characteristics of conceptual functioning, such as those identified in the present study, additional data could be obtained pertaining to defensive styles, anxiety, or self-esteem. Such data might aid in the identification of groups obtained via cluster analysis and in the formulation of educational or treatment strategies for these respective groups.

The intent of the present investigation was to extend a physical analog matrix theory of cognitive structure and function to the analysis of conceptual behavior in two special groups, in comparison to the conceptual behavior of normal children of about the same age. To this end, samples of male pupils, ranging in age from nine to twelve, were drawn from the special class populations of a suburban area and from the normal class population of fourth, fifth, and sixth grade classes in an adjoining elementary school.

Both mentally retarded and emotionally disturbed subjects were expected to differ from normal subjects of about the same age, and neither group was expected to perform, in general, as adequately as the normal group on the Object Sorting Task. However, these groups were expected to differ from the normal group in different ways. Conversely, each special class group was expected to perform similarly to the normal group in certain respects. Predictions regarding patterns of similarity and difference were generated through the application of statements and research findings found in the respective bodies of literature on retardation and disturbance to the cognitive dimensions expressed by cognitive matrix theory.

It was concluded that evidence for these predicted similarities and differences was obtained, although not uniformly taking the hypothesized form and often not to the extent predicted. The mentally retarded subjects in the present sample did appear to differ from the normal subjects in terms of quantitative aspects of Object Sorting Task performance, but also in certain qualitative respects. Emotionally disturbed subjects, while differing from the normal group in certain qualitative respects, did not perform in a manner substantially different, in general, from the retarded individuals along these same dimensions. In addition, some suggestions of particular aspects of quantitative differentiation, in terms of cognitive matrix theory, was obtained for normals and disturbed subjects, which were apparently not related to performance on IQ measures.

The above findings were very suggestive of the need for further research. In view of the high degree of variability within each special group, and the apparent overlapping of subjects in these groups along several cognitive dimensions, statistical procedures such as the cluster analysis program employed in the present study would seem to be potentially very useful tools in the conduct of such research.

In general, this study presented evidence of the heuristic merits of cognitive matrix theory in exploring the cognitive functioning of exceptional children, and the utility of the Object Sorting Task as a method for such exploration. The study also offered a number of specific implications for application of the theory and utilization of the task in subsequent research with mentally retarded and emotionally disturbed children.

APPENDIX A

OBJECT SORTING TASK (OST)
ADMINISTRATION PROCEDURES

OBJECT SORTING TASK (OST)
ADMINISTRATION PROCEDURES

I want to see how many ways you can think of to put things into two groups. All of the things in a group must be the same in some way. I will show you what I mean.

(PLACE PENCILS BETWEEN THE CIRCLES ON THE ADMINISTRATION BOARD WITH THE ERASER ENDS POINTING TOWARD THE EXAMINER.)

See these pencils? They are all mixed up. (MIX UP.)

Now, suppose I asked you to put three pencils in this circle (POINT) and three pencils over here in this circle (POINT) so that all of the pencils here in this circle (POINT) are all the same in some way and all the pencils over here (POINT) are the same in some way. You could do it like this. (SORT PENCILS)

See these pencils? (POINT LEFT) They are all the same because they are all new. They have never been sharpened. (POINT TOWARD UNSHARPENED END OF PENCILS.)

These pencils are the same (POINT RIGHT) because they are not new (POINT TO POINTS). They have been sharpened.

Now I'll mix them up again (MIX UP AND PUT BETWEEN CIRCLES AGAIN.)

Suppose I asked you to sort the pencils again, except this time in a different way. You could do it like this. (SORT PENCILS)

See, these are all the same because they all have erasers (POINT) and these are the same because they don't have erasers (POINT).

Always sort them into two groups. Always three things here (POINT LEFT) and three things here (POINT RIGHT).

(MIX UP PENCILS AND PUT IN CENTER.)

Now, can you see still another way to divide up the pencils into two groups? A way that we haven't tried yet?

(IF SUCCESSFUL, SAY:) Fine. Why did you put them that way? That's right: "These are the same because they all have pocket clips (POINT) and these are all the same because they don't have pocket clips"(POINT).

(IF THE CHILD IS UNSUCCESSFUL, SORT THE PENCILS WITH THE POINTS TOWARD HIM AND SAY:) See, here is another way. These are the same because they all have pocket clips (POINT) and these are all the same because they don't have pocket clips (POINT).

Do you get the idea? Do you understand what it is that we are going to do? (IF THE CHILD SAYS "NO," PARAPHRASE THE INSTRUCTIONS AGAIN.)

(IF THE CHILD SAYS "YES," SAY:) O.K., then, we can start, except this time, instead of pencils, (REMOVE PENCILS FROM SIGHT), we will use these blocks.

(TAKE BLOCKS FROM STORAGE AREA AND PLACE ON THE X's ON THE ADMINISTRATION BOARD.)

Can you see a way to divide up these blocks so that the three you put here (POINT) are all alike and the three you put here (POINT) are all alike? Go ahead and try it.

(BEGIN TIMING. RECORD TIME REQUIRED TO COMPLETE THE SORT.)

Why did you put them like that?

(WRITE RESPONSE ON PROTOCOL, THEN RETURN BLOCKS TO THE X's AND SAY:) O.K, now let's see if you can find another way to sort the blocks. (INDICATE FOR THE CHILD TO TRY AGAIN.)

Why did you sort them that way?

(WRITE RESPONSE ON PROTOCOL, THEN RETURN BLOCKS TO X's) Can you see still another way to do it? (INDICATE FOR THE CHILD TO SORT THE BLOCKS AGAIN.)

(ETC.)

(CONTINUE UNTIL THE CHILD INDICATES HE CAN FIND NO MORE WAYS TO SORT THE BLOCKS, EXCEEDS 120 SECONDS IN PERFORMING A SINGLE SORT, PERFORMS NINE DUPLICATE OR ERRONEOUS SORTS, OR PERFORMS A SINGLE SORT FIVE TIMES. THE FIRST TIME A CHILD SAYS HE CAN SEE NO MORE WAYS, HE MAY BE REMINDED THAT HE STILL HAS MORE TIME.)

(UPON THE TERMINATION OF THIS TESTING PROCEDURE, SHOW THE CHILD, IN ORDER OF DIFFICULTY, EACH SORT HE HAS NOT PERFORMED CORRECTLY, CONTINUING UNTIL HE HAS MISSED OR EXCEEDED 120 SECONDS IN IDENTIFYING THREE SORTS. RECORD EACH VERBAL RESPONSE AND THE TIME REQUIRED TO IDENTIFY EACH SORT.)

APPENDIX B

OBJECT SORTING TASK (OST)

SCORING GUIDE FOR SORT VERBALIZATIONS

OBJECT SORTING TASK (OST)
SCORING GUIDE FOR SORT VERBALIZATIONS

All positive sorts, both divergent and convergent are scored for verbalization. Duplicates, blank and false positive sorts are not scored. The scoring rationale is as follows:

"0" is given for motoric gestures only, "I don't know" response, and for verbalizations that appear to be given just to satisfy the adult demand for an explanation. (This type of responding is usually found only with very young children.)

"1" is recorded if the explanation can be justified, but only be means of considerable extrapolation on the part of the scorer.

"2" is given when the subject demonstrates an implicit recognition of the correct attribute. In this case he apparently has the correct idea with regard to the attribute; however, the conceptualization of that attribute is so poorly organized that the explanation often includes erroneous and/or inaccurate statements. That is, his verbal justification of his sort is arrived at by attempting to force on the object certain attributes that they don't, in fact, have.

"3" is recorded when the subject explicitly states the correct attribute. Here the verbalization consists essentially of detailed descriptions of the correct attribute and/or qualifications of "1" point responses; such as changing an adjective like "round" to a modifier such as "roundish"; this eliminates erroneous assertions about the blocks. The response must be correct but not necessarily comprehensive.

"4" is recorded for a precise, and concise, statement of the significant attribute. A "4" response is a high order abstraction whereas the "3" point response is essentially descriptive and concrete in nature. The availability of such a precise statement suggests that the concept is clearly defined in the child's mind and is available for use on demand.

Examples:

Sort #1 - Roundness.

0 - no answer, motoric gesture, "I don't know,"these match with each other, go together"

1 - ambiguous answer, not round, not square

2 - correct idea but very poorly stated, often including an erroneous or inaccurate statement, such as "round corners," "these are all round," "these have sharp edges," "these are circles," "these are squares," "these have pointed ends," "these are like cubes," "these have round edges," "these are elipse and circles."

3 - an attempt at a qualified statement. Example: roundish, circular, rounded off, rounded lines, oval shaped, round in some places, squarish. Sometimes a child might also focus on some subset of attributes associated with the more general concept being sought. For example, square edges, straight lines, all sides are flat, curved sides, 8 points, almost round, almost square.

4 - a 4 point response is a precise statement of the significant attribute. Example: angular, rectalinear, curvilinear, these are straight and these are curved-lined objects.

Sort #2 - Hue (Red-Blue)

0 - no answer, "I don't know", "these match with each other, go together"

1 - not blue, not red

2 - red, pink, blue; these are red and pink and orange and these are blue; light colors--dark colors; these are almost red, these are almost blue.

3 - these are all colors of red; they're reddish, pinkish, bluish, blue colored; they're all different kinds of blue; they're reddish in tint; these are a blue hue.

4 - these are shades of red, blue; hue(s) of blue; these are in the red family.

Sort #3 - Transparency

0 - no answer, "I don't know, "these match with each other, go together," "these are pretty"

1 - ambiguous response; not clear, these are blocks

2 - implied optical properties: you can see scratches on the other side, it sparkles, it's shiny, translucent, it's made out of plastic, glass; these are painted and these are not, these are wood, light colors-dark colors, solid colors

3 - a functional optical property: you can see through these; it transmits light; it magnifies things; it catches or filters light (clear objects); it reflects light (opaque objects).

4 - clear, transparent, opaque

Sort #4 - Tall

0 - round shapes (when occurs in conjunction with "talls"); no answer, "I don't know," "these match with each other, go together"

1 - ambigious answer, not tall, not short

2 - big, little; small, these are level, these are all the same size

3 - these have long lines; these have short lines; these are high and these are low; these are flat.

4 - tall, short

Sort #5 - Beveled

0 -

1 - these are fatter than those; these are narrower than these. These have flat edges; all the bottoms are even, these are triangles, these are not straight.

2 - these curve out and these go straight; these get width as they go down; these are shaped like a pyramid; these go out; these go out at the bottom; these tilt down; these are cone shaped; these are bigger at the bottom than at the top; these are bigger at the bottom than at the top; these come up in a triangular shape.

3 - the top edges are the same size as the bottom edges; these are shaped like a triangle with the top cut off; these are shaped like a pyramid with the top cut off; sort of like a pyramid; these are straight on the sides; these go straight up; these have slanting lines; these have slanting edges.

4 - a response indicates a recognition that it is the sides themselves that are slanting not some particular aspect of the side much as an edge. These have slanting sides; sloping sides, beveled sides; these sides are slanting; these sides are not perpendiculaar; these sides go straight up.

Sort #6 - Oblong

0 - no answer, etc.

1 - ambiguous answer, these are thinner; these are fatter.

2 - the implicit awareness of elongation but a very awkward or erroneous way of stating it. For example, these are long and these are not; all the tops are even (referring to the regular objects); all the tops are equal (implying length and width of the tops are equal for each top); these are all like cubes (referring to the regular objects).

3 - the explicit notion of proportionality, i.e., comparing length to width, but stated in a roundabout way. These are longer than they are wide. These are skinny compared with their size. These are longish; any quality of radialaxes, these fiqures are all like circles, they approach a circle in shape, (all referring to regulars).

4 - The verbalization should indicate the presence of a well and clearly defined verbal label for the criterial attribute: elongated, oblong, regular.

Sort #7 - Pastel

0 -

1 - ambiguous answer

2 - light colors, dark colors, bright and dark colors.

3 - These have light shades of red and blue and these have dark shades of red and blue.

4 - A statement with regard to the fact that these are pastels and these are not; or these are pastels and these are intense colors.

Sort #8 - Volume

0 - these are taller

1 - ambiguous response

2 - big, little, small, large, hearvier, lighter, thin, thick, these are bigger than these.

3 - Larger in size, smaller in size; these would hold more water than these if they were empty; it would take more material to make these than these, these weigh more.

4 - The volume of this group is larger than the volume of this group. These have large volumes; these have small volumes; etc.

Sort #9 - Area

0 -

1 - ambiguous answer

2 - An implied recognition of area differences but very

poor specifications, such as, these are fatter than these; these are skinnier than these; these are thinner than these; these are big and these are little, these are bigger than these.

3 - These cover up more of the table top than these; it would take more paint to paint the bottoms of these; these bottoms are bigger than these; these these have big bottoms and these have little bottoms.

4 - A statement to the effect that this group has a larger basel area than the other group. The base areas of these are larger than the base areas of these.

APPENDIX C

OBJECT SORTING TASK (OST)

SCORING DIMENSIONS

OBJECT SORTING TASK SCORING DIMENSIONS

Variable

1 **No. of Positive Sorts--with Verbalization:** This is the sum of the number of positive arrangements of blocks for which verbal explanations have been offered. The child may not have been able to verbalize his sorting rationale entirely adequately, however.

2 **No. of Positive Sorts--without verbalization:** For this index the child has an appropraite arrangement of blocks, but does not have the capacity to mount even weak verbal justification for his arrangement. If the child is asked why he arranged the blocks in the way he did, he may often respond with "I don't know" or even give some entirely vague, ambiguous, or seemingly random or unintelligible verbalization. It is presumed that the positive sort has been achieved via preverbal or nonverbal representation systems.

3 **Total No. of Adequate Positive Sorts:** This index is the number of adequately verbalized, i.e., non-zero positive sorts plus the number of non-verbalized positive sorts, that is, the sum of variables one and two, Var, 1 + Var. 2.

4 **No. of False Positive Sorts--Positive Sorts with Erroneous Verbalizations:** A false positive sort is a positive block arrangement not previously used given with a well delineated but unacceptable verbalization so that the examiner may safely conclude the subject based his sorting behavior on inappropriate

conceptualization. The most common false justification is a 2-1, 1-2 basis for sorting. But external relations and imputed meaning may also be involved.

5 No. of Duplicate Sorts: This index is the number of times a child repeats a valid sort. For the IIV-SAF-HAN studies the range is 0-9. The verbalization for the duplicate sort need not be similar to that previously given, however, nor even of the same class. A dup may even involve erroneous verbalizations.

6 No. of Times a Blank Sort Appears: Code 0 if blank sort never given. Code 1 if given once, etc.

7 Total No. of All Sorts Executed: This index is the total number of sorts given regardless of verbalization or justification; that is, it is the sum of Variables three, four, five, and six: Var. 3 + Var. 4 + Var. 5 + Var. 6.

8 Proportion of Positive, Verbal Sorts: This is found by taking the ratio of the number of positive verbal sorts to the total of all sorts executed; that is, the ratio of vatiable one to seven: Var. 1/Var. 7. If ratio is 1,000, score .999.

9 Proportion of All Adequate Positive Sorts: This is the ratio of the total number of positive sorts to the total number of all sorts executed; that is, the ratio of variables three to seven: Var. 3/Var. 7. If ratio is unity, score .999.

10-18 Rank Order of Appearance of Each Positive Sort (Sorts Arranged by Difficulty): Here a number is assigned to each positive sort according to the order in which they appeared in the subject's protocol. Duplicate and "blank" sorts are not included. If the sort never occurred, score 0. The order of difficulty is as follows:

Sort #	Attribute Dimension
1	Round - Square
2	Blue - Red
3	Transparent - Opaque
4	Tall - Short
5	Beveled - Perpendicular
6	Oblong - Rectangular
7	Pastel - Intense
8	Large Volume - Small Volume
9	Large Area of Base - Small Area of Base
10	Blank

19-27 Speed of Each Adequate Positive Sort: This is the time, in seconds, it took the subject to complete a positive sort. (See Administration Section for details on timing procedure.

28 Mean Speed of Adequate Positive Sorts: This is the mean time, computed in seconds, for a child to complete an adequate positive sort: Var. 19 + Var. 20. . . Var. 27/Var. 3 + Var. 4.

29 Ordinal Mean Verbalization Score for Positive Verbal Sorts: This is arrived at by adding the verbal score for the two poles comprising a sort; that is, by summing the polar scores; e.g., column 2 + column 3; column 4 + column 5, and dividing by the number of sorts.

30 Derived from Ordinal Mean Verbalization Discrepancy Score for Verbal Positive Sorts: This score is arrived at by taking the absolute difference between the scores of the two poles of the classification dimension, summing, and dividing by the # of scored sorts. Round off result to nearest tenth. (See Verbalization Scoring Manual.)

31 Pencil Sort Comprehension:

1 = child got clip sort on pencils

0 = child missed clip sort when first administered

32 No. of Internal Relational Sorts: Here the composition of the groups rather than the characteristics of each block form the basis of the sort. For example, "This group has two red and one blue and this group has two blue and one red."

33 No. of External Relational Sorts: The blocks take on meaning by their relationship to some external reference. For example, "These are on my left and these are on my right."

34 No. of Convergent Positive Sorts: Number of convergent positive sorts adequately explained.

35 Mean Verbalization Score--Convergent Sorts: See verbalization scoring procedures. This is based on the sum of both poles.

36 Total Convergent + Divergent Sorts: This does not include duplicated sorts or blank sorts. A 2-1 false positive sort, however, which is counted in Divergent score may appear again as a correctly recognized convergent sort. This is Var. 3 + Var. 4 + Var. 34.

37 Flexibility Score on Block Sort Test: The different sorts can be grouped into several common categories: form, color, relational sorts. The flexibility score is the number of shifts from one category to another. Only adequate positive sorts are taken into consideration. The presence of any number of duplicate sorts between two positive sorts of two different classes does not nullify the shift.

38 Condition Under Which Test Was Terminated:

1 = Child quits
2 = Subject takes 120 seconds
3 = Too many duplicates (over 9)
4 = Too many identical duplicates (5)

39 Number of Categories Employed in Verbal Justifications: This is the number of different valid sorting dimensions (hue, height, volume, etc.) employed in verbalizations for all sorts performed on the Divergent Task. The maximum score is 9.

40 Number of "Sign" Sorts: The number of times where the blocks are taken to stand for something. Meaning is imputed to them. Examples: "These look like lamp shades," "These are bathtubs," etc. (Divergent sorts only.)

41 Number of Primitive Functional Sorts: This is the number of times where there is an animistic quality in the verbalizations which implicitly attributes intentionality to the object. This should not be confused with a sophisticated description of function where the locus of intentionality lies clearly within the individual (e.g., "You can see through these.") Examples of Primitive Functional sorting verbalizations are: "These can cut," "These can hurt you," etc. (Divergent sorts only.)

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